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THE GRADUATION EFFICIENCY INDEX: Validity and Use as an Accountability and Research Measure

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Legislatures and coordinating boards are looking for efficiency measures as greater numbers of students wish access to higher education. We propose the Graduation Efficiency Index (GEI) as an efficiency measure that is more valid and useful than elapsed time from matriculation to degree (time to degree). The index is computed by subtracting the number of transfer credits from the minimum credits required for the degree, then dividing the remainder by the sum of the enrollment census day credits in which the given student has enrolled while in college. Research is reported in which this index is applied to data from 1993–94 University of Washington bachelor-degree recipients. Among the results, nontransfers were found to graduate with more efficiency than transfers and B.A.-degree recipients with more efficiency that B.S. recipients. The GEI correlated only modestly with time to degree and part-time vs. full-time enrollment status, and correlations with admissions data were quite small.

The children of the baby boomers are about to reach college age (*The Almanac of Higher Education*, 1995). The Washington State Higher Education Coordinating Board indicated that for its state, "Between 1995 and 2020, the number of 17–25 year olds (the traditional age range for most college students) is projected to increase by 32%. High school graduates . . . are expected to increase by 49%" (Higher Education Coordinating Board, 1990, p. 11). As legislatures and institutions across the country anticipate the fast-approaching bulge in the number of students seeking a college education, there is much concern about how these increasing numbers of potential students will be educated (see, for example, *Access to Higher Education in the State of Washington: Implications for State Policy*, 1995). Little hope is held for the resources devoted to higher education in the public or private sectors rising commensurately (Ewell, 1994).

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Thus, attention has turned to efficiency with which students are educated and how it can be increased (Peters, 1994). A general definition of efficiency is "the ratio of the effective or useful output to the total input in any system" (*American Heritage Dictionary*, 1992). The purpose of this article is to present a new method of indexing efficiency in the context of educating undergraduates and to present evidence for its validity and usefulness for accountability and for research, particularly in contrast to use of time from matriculation to graduation (time to degree) for these same purposes. This index is based on the ratio of minimum required degree credits (output) to credits attempted (input).

TIME TO DEGREE AS A MEASURE OF EFFICIENCY

In the State of Washington, one perceived source of inefficiency receiving a great deal of attention from the legislature is the time students take to graduate. The underlying perception is that students who take longer than the prescribed four years to graduate are expending disproportionate amounts of educational resources, thus leaving less of these valuable resources for other students who seek higher education. The proportion of students who graduate in four, five, and six years has been proposed as one of five accountability indicators by the state's Higher Education Coordination Board (Gaspard, 1996) and by other states (Richardson, 1994).

Nationally, the majority of undergraduate students enrolled in public institutions take longer than the "standard" four academic years from the time they first enroll either at a four-year or a two-year school until they graduate (National Center for Educational Statistics, 1993). For example, of the 3,487 students who enrolled directly from high school for the first time in 1991 at the University of Washington (UW), 36.7% had graduated by the end of academic year 1994–95, 26% had left UW, and 37.3% were still enrolled (University of Washington, 1996). The average four-year graduation rate of students entering as freshmen in 1988 across the 26 universities that participate in the Association of American University Data Exchange was 34.8% (AAUDE Homepage). Thus, only about one-half of the students who first matriculate and then graduate from the same university do so in four years.[1] The percentage is lower for those who transfer at some point.

That students who take longer than four years add inefficiency to a state's higher education system follows from the assumption that if each student were in college for a shorter period of time, from matriculation to graduation, more students would be able to attend college because students who are enrolled for a longer period leave fewer spaces for other students. But does this reasoning hold up under careful review? The student who enrolls part-time takes up no more total enrollment space than the one who enrolls full-time if they both take the same number of total credits over the course of their studies. Two students

each taking two courses consume the same amount of *instructional resources* as one student taking four courses.

All college expenditures are not associated with instruction and it is true that, relative to full-time students, part-time students consume nearly as many student service resources such as registration, counseling, and advising. However, student service expenditures usually make up a relatively small portion of total expenditures—4% at the University of Washington (University of Washington, 1996; Brinkman, 1989). All other expenditures vary directly with the instruction taken, not with student head count. Clearly, the amount of instructional space a student consumes contributes significantly to the cost of education independent of the calendar time it takes him/her to graduate. Thus, calendar time may not be a valid measure of efficiency. Speaking from the point of view of a commissioner of Texas higher education, Ashworth (1994) stated that, "The touchstones for any performance funding system should include availability of data, simplicity, and flexibility" (p. 11). Noticeably absent from his list is the most important attribute of all: *validity*. The validity of a measure cannot just be assumed. In the current case, institutions graduating higher percentages of students in four years may be no more efficient in educating students than institutions graduating lower percentages.[2]

Calendar time from matriculation to graduation as an accountability measure may also have unintended negative consequences, which also causes validity problems (Messick, 1989, 1994). The traditional model of student behavior in which a student enrolls directly after completing high school, attends college for four years, taking summers off to work, and graduates in June is increasingly discrepant from actual student behavior (Higher Education Coordinating Board, 1990; Outz, 1995); so is the two-plus-two model for transfer students. Current-day students are apt to first attend a community college part-time, return to finish a degree after working several years, or obtain a second degree in a different field. Particularly as higher education reaches out to more diverse populations, through distance learning, for example, using calendar time from matriculation to graduation as an efficiency measure may become increasingly problematic. More and more students are place-bound and will receive a major portion of their college education in remote locations, and are likely to proceed more slowly in so doing.

The four-year model is also inappropriate for those economically disadvantaged students for whom a college education is not affordable without an extensive work schedule that renders a full load of courses difficult if not impossible (Volkwein and Lorang, 1996). Stressing the importance of a high four-year graduation rate has the unfortunate side effect of punishing institutions for admitting economically disadvantaged students such as single mothers—students whose desire for higher education should be honored rather than disparaged. An unfortunate side effect to using calendar years from matriculation to graduation

as an efficiency measure is that institutions opening their doors to these students will be under the threat of punishment.

Finally, in making the argument that time alone does not equate to efficiency we add that there are student-reported reasons for delays, most prominently the need to take lighter loads in order to work (Gillmore, 1992), and empirically derived correlates, such as the additional time that results from each change of major (Gillmore, 1994). The most prominent reasons for extended time given by students and by parents (Sanford and Rivera, 1993) are those over which institutions have little control. It is perfectly reasonable to assume that students should have a large degree of control over the pace of their education. To use a very telling example, if a student decides to take a year off to bear and rear a child, the time for that student's degree is lengthened commensurately. It seems unfortunate to discourage such activities because they appear to decrease institutional efficiency, especially if, in fact, they have little or no impact on real efficiency.

DEFINING THE GRADUATION EFFICIENCY INDEX (GEI)

Our argument so far is that the number of calendar years between when a student first enrolls and when she graduates is not a valid measure of the efficiency by which colleges are producing degrees and using resources, and as a measure it has unfortunate consequences. A more appropriate measure is one that is based on the amount of instructional space that a student occupies over the course of his or her studies.[3] In particular, we propose the Graduation Efficiency Index (GEI), which is intended to be a single, easily computable index of the efficiency with which students move through the higher education system.

The GEI is computed retrospectively *for each graduate* as follows:

$$\text{GEI} = \frac{(\text{Minimum Required Credits for the Degree} - \text{Transfer Credits})}{\text{Sum of Enrollment Census Day Credits}} \times 100$$

This index avoids many of the problems that are associated with calendar years as a measure. Furthermore, it is a much more defensible measure of the efficiency with which an institution is producing graduates in that it takes the following five variables into account:

1. *The total number of credits that have been earned.* Earning more credits than the degree demands reduces efficiency.[4]
2. *The number of credits for courses that have been dropped.* Dropped courses, leaving empty seats, adds to inefficiency.
3. *The number of credits for courses that have been repeated, including failures.* Students who fill the same seat twice add to inefficiency.

4. *The minimum number of credits required by the major for graduation.* Degree programs that legitimately require more credits do not necessarily add to inefficiency.
5. *The number of credits that have been transferred.* Given that students move from institution to institution, prior work needs to be recognized but not credited to the degree-granting institution.

The GEI Incorporates these five variables in a straightforward way. It has a number of additional advantages:

(a) The GEI varies from zero to 100% and is readily interpretable. For example, an efficiency rate of 90% has familiar meaning, being commonly applied to furnaces and engines.
(b) It can be used at all degree levels and all institutions where there is a standard and acceptable minimum number of required credits for a degree. (We have chosen to restrict our attention to undergraduate degrees here, but this restriction is not necessary.)
(c) It is equally applicable to full-time and part-time students.
(d) It can be averaged for subsets of students; for example, for each degree type, for each department, and for transfer vs. nontransfer students. In other words, it is an index that is very useful as a dependent or correlative variable for research and for illuminating problem areas, as will be demonstrated below.
(e) It can be easily tracked over time to assess affects of interventions and policy changes to improve efficiency, either locally or globally.

CALCULATING THE GRADUATE EFFICIENCY INDEX

Enrollment Census Day Credits

The denominator of the GEI for each student is the sum of the enrollment census credits in which the student has enrolled over the course of his or her career at the given institution. At UW this is the tenth day of each quarter. We have chosen to sum enrollment census day credits for two reasons. First, we wanted to choose a time after which if a student dropped a class, his or her place was less likely to be taken by another student. The tenth day at UW seems to be a good compromise—if one waits longer, the inefficiencies caused by dropped courses will be missed. If one chooses an earlier date, vacated spaces may be reassigned to other students. At the University of Washington it is possible for students to enroll after the tenth day with special permission—our index misses these. It is also possible for students to drop before the enrollment census day and not have their space filled. In this regard, the index is flawed.

Second, student record systems make counting at the enrollment census day relatively easier than counting at any other time because it is the official day for reporting enrollments to the state. Such practical circumstances might require other institutions to define this variable somewhat differently. This redefinition should not be a major problem if the institution is internally consistent and is not comparing itself with others that use alternative definitions.

Total Credits Required for Graduation

This variable is intended to be represented by a value for each possible undergraduate degree type and major. It is not empirically determined but is based on what the official institutional catalog indicates. At UW it equals 180 quarter credits for most programs but can range up to 225 credits.

Transfer Credits

We recognized early on that transfer credits[5] had to be an element of the index and that the index for transfer students should be comparable to, though not necessarily equal to, that of nontransfer students. However, our database is such that we can determine the number of transferable credits for each student, but we cannot determine the efficiency behind these credits. In particular, when a transfer student's total credits are in excess of minimum credits required for graduation, it is not possible to attribute the excess credits to one or the other institution.

There appear to be two ways to handle transfer credits that lead to somewhat different results. The GEI, as it is defined above, subtracts transfer credits from the numerator. The implication of this choice is that the efficiency at the sending institution is estimated by the efficiency at the graduating institution and is weighted by the relative number of credits taken at both places.

An alternative formulation adds transfer credits to the denominator rather than subtracting them from the numerator. Efficiency as computed by this alternative formula is always equal to or larger than by the formula above. It implicitly assumes that all of the transfer work was done with 100% efficiency, that is, all course work taken contributed to graduation—no courses were dropped after the tenth day, no courses were repeated, no courses were unnecessary for fulfilling graduation requirements, and so forth. By direct implication, it assumes that all inefficiency is manifest by the transfer student at the graduating institution.[6]

Empirically, we found that the average efficiency index of transfer students was almost exactly equal to the average efficiency index of nontransfer students under the alternative version, yet we are confident that the transferring process adds some degree of inefficiency when one views the entire undergraduate ca-

reer of a student, not just that at the degree-granting institution. Thus, we prefer the initial GEI formulation because of the theoretical rationale explained above and because our empirical results suggest that the alternative formulation does indeed overestimate the efficiency of transfer students. Furthermore, while the GEI is not necessarily strictly correct for every transfer student, we feel it is representative on average.

LIMITATIONS

Conceptually, there are three major limitations to the GEI. First, as elaborated directly above, the efficiency of the academic programs of transfer students at the sending institution must be inferred from the efficiency demonstrated at the degree-granting institution. Institutions that have relatively small proportions of transfer students might easily ignore this limitation by excluding them from their calculations. A better solution is to capture the entire transcript from the sending institution, including late withdrawals and nontransferable credits, which would present a more accurate calculation of the total inefficiency but still would not be able to apportion it to each institution attended.

Second, the GEI is a measure that at this stage of development can be applied only to students who have obtained degrees. Taken alone, it implies that the goal of undergraduate education is fully or at least primarily embodied in these degrees, and it ignores students who matriculate but fail to graduate. The GEI is not a measure of graduation rates. The simplest way to deal with this limitation would be to do separate calculations of graduation rates and the GEI and to try to improve both. Alternatively, one could attempt to merge the two measures. However, with the individual student as the unit of measurement, it is difficult to conceive of an index analogous to the GEI without a determination of the value of a degreeless college experience. Otherwise, the efficiency of all noncompleters would have to be set equal to zero because all expended resources failed to produce the desired result—a degree. This latter formulation feels particularly dissatisfying.

Finally, efficiency is clearly not equivalent to effectiveness. One criterion by which performance or accountability indicators should be judged is by the institutional behavior that they reinforce. We argued at the beginning of the paper that simple measures of calendar years from matriculation to graduation may lead to some unfortunate consequences, such as favoring students of wealth over students of economic disadvantage and favoring young, traditional students over older returning students. The GEI is not without the possibility of adverse consequences. For example, students who take additional credits. credits that do not count toward a degree but might contribute to further employment, or even who drop some courses may, in fact, receive a better education in terms of society's larger goals.

Further, the GEI assumes that the academic units' determination of the curriculum and the minimum number of credits required for a degree is appropriate. However, by raising the minimum number of credits required for the degree, academic programs can artificially raise their measured efficiency levels while lowering actual efficiency. Clearly, care must be taken to assure that program credit requirement minimums that exceed the institution's minimum are grounded on academic necessity. As Ewell (1994) has pointed out, we need to address more generally "the common meaning of academic awards given in common . . . What the baccalaureate really is supposed to mean" (p. 29).

USING THE GEI

In the remainder of this paper, we present research that uses the GEI as a dependent and as a correlational measure. Our purpose in presenting this research is essentially twofold. First, if the GEI is indeed a valid measure of a valid concept, then we must demonstrate that this measure can be used in research to increase understanding and guide efforts toward improving the efficiency with which students move through an undergraduate degree program. In other words, can we use this measure to learn about the issues involved? Second, we need to demonstrate that the GEI is a distinct measure from simple calendar years from matriculation to degree.

The research questions we pose are as follows:

1. Is there a significant difference in graduation efficiency between transfer and nontransfer students and between bachelor of arts and bachelor of sciences recipients, and is there a significant interaction between the two variables?
2. Similarly for sex. Is there a significant difference between males and females and does sex interact with degree type or transfer status?
3. Is there a difference in GEI among students in categories of transfer credits and by the type of school last attended (high school, two-year college, and four-year college)?
4. What is the relationship between the GEI and the calendar years from matriculation to graduation?
5. We know that part-time students take longer to graduate. Is the average GEI for part-time students higher than full-time students?
6. To what extent does GEI correlate with admissions measures (high school GPA, transfer GPA, and admissions test scores) and GPA at graduation?

THE DATA

The research to be described was based on all graduates of UW who received a bachelor degree during the 1993–94 academic year. In preparing to do this

and related research a retrospective database was developed that started with the graduates and worked back in time cumulating their academic transcripts. Also included in this database are major program and admissions information. For the analyses to follow we excluded students who graduated with majors in two fields or who graduated with more than one degree because their programs would naturally lead to the appearance of greater inefficiency and thus not be comparable to the rest of the student body. Also excluded were students whose calculated GEI was 0 or less or greater than 1. There were 52 of the former and 313 of the latter. These GEIs were the result of incomplete electronic records related to course work or transfer credits. The final population consisted of 4,953 graduates.

RESULTS

Overall Institutional Results

The average GEI for all UW graduates was calculated to be 85.0, with a standard deviation of 15.0. Thus, by this index, the institution is graduating students with 85% efficiency. Only 8.5% of the population had a perfect GEI of 100.

Degree Type and Transfer Status

Students were placed into two groups based on whether they had 30 or more transfer credits or not at graduation. There were 2,539 transfer students and 2,414 nontransfer students by this definition. Similarly, students were divided into those with bachelor of arts degrees (N = 3,454) and bachelor of science degrees (N = 1,425). Seventy-four students had bachelor degrees that did not distinguish between arts and science.

A two-way analysis of variance was run with transfer status and degree type as independent variables and GEI as the dependent variable. The results are in Table 1. All effects were significant ($p < .001$). The results are plotted in

TABLE 1. Analysis of Variance Results: Transfer Status by Degree Level

	SS	D.F.	MS	F
Main Effects				
Degree Level	3.87	1	3.87	296.30
Transfer Status	7.93	1	7.93	398.17
Interaction	0.76	1	0.76	38.02
Error	97.04	4875	0.02	
Total	109.60	4878		

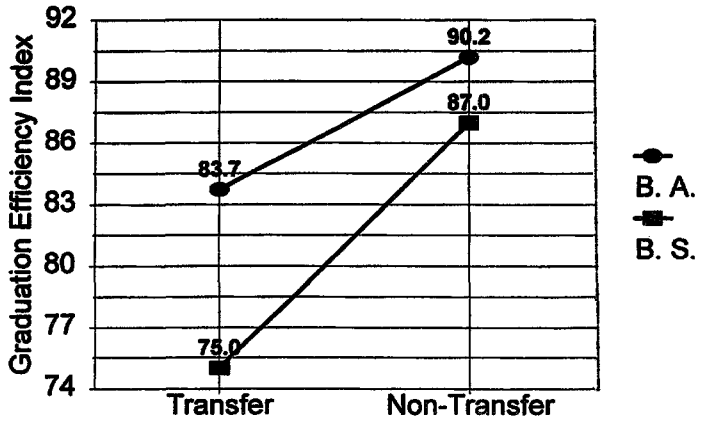

FIG. 1. Degree type by transfer status.

Figure 1. One can see that the GEI is higher for B.A. recipients than for B.S. recipients. It is also higher for nontransfer students than for transfer students. The shape of the significant interaction between the two variables indicates that transfer students obtaining B.S. degrees were disproportionately less efficient than those seeking B.A. degrees. From an institutional perspective, this result clearly targets a problem area toward which additional research can be directed.

Number of Hours Transferred

The number of transferred credits appears in the numerator of the equation for the GEI as a subtracted variable. Yet the GEI is not constrained to be negatively correlated with transfer credits because every credit that is subtracted from the minimum required credits in the numerator can also diminish the sum of the enrollment census day credits. In other words, in theory, every credit transferred is one less that needs to be taken for a degree. But is this indeed the case?

To address this question, a variable was created by placing graduates into categories of 30 credit intervals based on the number of credits each transferred. Table 2 presents these categories and number of graduates, the average GEI, and the average age of each group.

The results of a one-way analysis of variance indicated that the differences among the average GEIs for the graduates within these categories were highly statistically significant ($F = 546.67$, $df = 5,4947$, $p < .0001$). The value for eta squared was .36, indicating that the number of transfer credits accounted for 36% of the variance in GEI.

TABLE 2. Categories of Transfer Credits

Category	*N*	Avg. GEI	Avg. Age
0–30	2431	89.2	23
31–60	363	84.5	25
61–90	1388	85.4	27
91–120	491	81.7	30
121–150	212	61.3	31
151 and above	68	27.0	33

In viewing the means, one can see that there is a small drop from 0–30 credits to 90–120 credits, but that a steep drop occurs at 121–150 credits and at 151 and above credits. Since UW requires at least 45 credits to be completed in residence, a somewhat lower efficiency value is inevitable for anyone in a 180-minimum credit major who transfers more than 135 credits. However, the low efficiency that appears to accompany large numbers of transfer credits is not fully explained by this reality. An examination of the average age of graduates within each category suggests that large numbers of transfer credits may be associated with older persons returning to college, perhaps to finish a degree.

Sex

The sample contained 2,651 females (53.5%) and 2,302 males (46.5%). To determine the effects of sex on GEI, a three-way analysis of variance was conducted on sex, transfer status, and degree type. The results are found in Table 3. The main effects for the latter two items and their interaction is reported above and not repeated in this table.

Figure 2 presents the means for the main effect and for the degree type by sex interaction. One can see that females have a mean GEI that is 2.4 points higher than males across all graduates. However, if one looks within degree types, the higher mean for females pertains only to B.A. degree recipients. The

TABLE 3. Analysis of Variance Results: Sex by Transfer Status by Degree Level

	SS	D.F.	MS	*F*
Sex	0.14	.1	.14	7.10*
Sex × Transfer Status	0.02	1	.02	1.17
Sex × Degree Level	0.13	1	.13	6.35*
3-Way Interaction	0.00	1	.00	0.07
Error	97.04	4875	0.02	
Total	109.598	4878		

*$p < .01$.

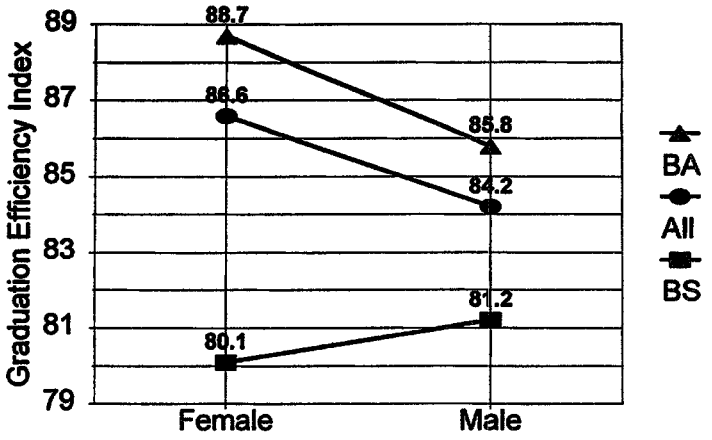

FIG. 2. Sex by degree type.

mean for male B.S. degree recipients is actually slightly higher than that for females.

Last School Attended

The graduates in the sample were classified in regard to whether the last school they attended before entering UW was a high school (N = 1,942), a two-year institution (N = 1,493), or a four-year institution (N = 1,469). Several analyses were done on this variable. First, we computed a one-way analysis of variance, with GEI as the dependent variable and last school attended as an independent variable, the results of which were highly significant ($F_{2,4901}$ = 194.83, $p < .0001$).

In Figure 3, the means of the three groups are plotted. Given that the earlier results showed a significant difference between transfers and nontransfers, the large difference in GEI between high school and both two-year and four-year transfers is expected. The statistically significant difference ($p < .001$) between two-year and four-year transfers was not expected. We wondered whether this difference might be an artifact of university regulations that state that students from two-year institutions can transfer no more than 90 credits, whereas there is no limit on four-year transfers. We tested this hypothesis by restricting the sample to just those with 90 or fewer credits and found no diminution of the difference between the two groups. Finally, we also tested for the significance of an interaction of last school attended with degree level, restricting attention to transfer students. It was not statistically significant. Thus, we conclude that students transferring from four-year schools tend to do so with less efficiency,

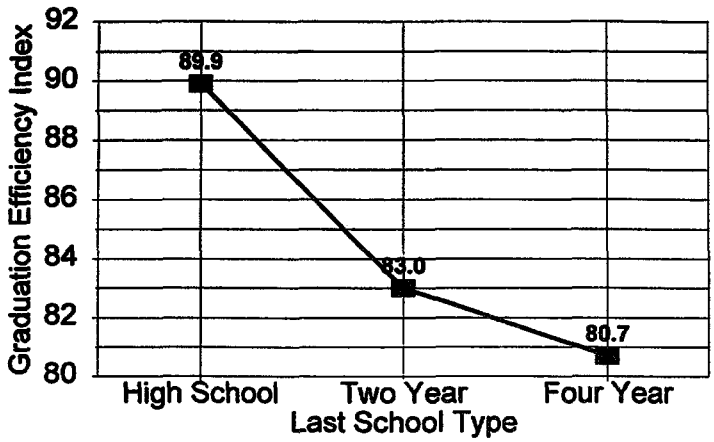

FIG. 3. Last school type.

as measured by the GEI, than students who transfer from two-year schools. One possible explanation for this difference is that the State of Washington has a large community college system, and a great deal of effort is put into articulation between community and baccalaureate institutions. Considerably less attention has been placed on articulation among four-year schools.

Relationship with Time to Degree

We have posed the GEI as a better measure of efficiency than time from matriculation to graduation. It is possible that the two measures are so highly related that the distinction is unimportant. In Table 4, we present the average GEI and average time to degree from matriculation at the University of Washington. Because of the significant interactions with degree level and transfer status presented above, statistics were computed across all transfer and nontransfer students and within each of the four groups that result from crossing degree type (B.A. vs. B.S.) with transfer status (Tr vs. NTr). For this analysis, years as a variable was divided into fourths, corresponding to academic quarters. We also present the statistics for the subgroup of transfer students who transferred from 80 to 90 quarter credits. The latter is included because a larger range of transfer credits naturally reduces the correlation of time and GEI. This reduction is a result of the number of years at the institution of graduation varying inversely with the number of credits transferred. Thus, there is an added source of variance in the years measure that is independent of the GEI.

The correlations range from $-.35$ to $-.48$ for the four groups. The magni-

TABLE 4. Relationship of GEI and Time to Degree

Group	*N*	Avg. GEI	Avg. Time	*R*
B.A. Nontransfer	1741	90.2	4.9	−.37
B.S. Nontransfer	712	87.0	4.8	−.41
B.A. Transfer (All)	1781	83.7	3.7	−.19
B.A. Transfer (80–90 credits)	789	88.5	3.2	−.35
B.S. Transfer (All)	767	75.0	3.4	−.18
B.S. Transfer (80–90 credits)	337	80.3	3.2	−.48

tude of all of these correlations is significantly different from zero, thus indicating the presence of a relationship, but the two measures possess only from 14% to 23% of shared variance. The negative sign of the correlations is predictable since more time is expected to be related to less efficiency.

We take these relatively weak correlations as a strong indication that these two measures of efficiency are empirically as well as conceptually distinct. They show that students within the same group can take less time while being less efficient, and students can take more time while being more efficient as measured by the GEI. One can also see from Table 4 that even students who transfer from 80 to 90 quarter credits take an average of more than three additional years to graduate.

Part-Time vs. Full-Time Status

At the University of Washington, there is no official part-time designation. To examine the effects of this part-time enrollment we created a variable based on average credits enrolled per academic term enrolled. The correlation of this variable with GEI across all students was .20, which is statistically significant ($p < .01$), but small in magnitude. Smaller yet were the within-group correlations, ranging from .08 to .18

As a further analysis, since it takes a load of 15 credits per term to graduate in 4 years, excluding summers, we defined full-time students as those with an average of 15 or more credits. One must enroll for 12 or more credits to be eligible for financial aid. Thus, we defined a second group as those having an average of from 12 to less than 15 credits per term. Finally, we defined a third group as those below an average of 12 credits per term. Two-way analyses of variance (degree type, transfer status by part-time/full-time status) revealed no significant interactions; thus, in Table 5 we present only the averages over all students.

One can see a significant difference among the average GEIs for the three groups in the predicted direction. There is nothing inherent in the calculation of the GEI that constrains part-time students to have lower index values than full-

TABLE 5. Average GEIs by Full-Time/Part-Time Status

Status	*N*	Mean	S.D.
<12 Credits/Term	876	79.3	19.6
12–< 15 Credits/Term	3013	85.4	13.7
15 or more credits/Term	1064	88.7	12.7

$F_{2,4950} = 100.74$; $p < .001$.

time students. Nonetheless, these results suggest a small but significant lowering of the GEI related to part-time attendance.

Other Correlational Results

A number of variables were correlated with the GEI. As above, correlations were computed across the entire group and within each of the four groups that result from crossing degree type (B.A. vs. B.S.) with transfer status (Tr vs. NTr). These correlations are found in Table 6.

Admissions Data

The UW bases admissions for freshmen on high school GPA and on admissions test scores (usually the SAT). A formula that uses a weighted average of high school GPA (weighted approximately three-fourths) and SAT scores (weighted approximately one-fourth) is used to compute an admissions index on which students are ordered and selected. Students who transfer more than 45 hours are admitted on the basis of their transfer GPA alone. An equivalent admissions index is computed for these latter applicants.

One can see from Table 6 a small but positive correlation between GEI and

TABLE 6. Correlations with the Graduation Efficiency Index

	All	BA, Tr	BS, Tr	BA, NTr	BS, NTr
N	4953	1747	752	1707	673
HS GPA	**0.17**			**0.22**	**0.18**
2-Yr. GPA	**0.11**	**0.14**	**0.18**		
4-Yr. GPA	**0.11**	**0.13**	**0.16**		
SAT M	−0.04	−0.04	−0.06	−0.03	−0.09
SAT V	**−0.08**	−0.09	−0.11	−0.02	−0.04
Adm. Index	**−0.07**	**0.11**	**0.15**	**0.10**	**0.12**
UW GPA	**0.14**	**0.13**	0.05	**0.44**	**0.35**

Statistically significant correlations in bold.
$p < .01$.

high school GPA and the two transfer GPAs. The values are fairly consistent over all graduates and within the four groups where appropriate. In contrast, the correlations for both SAT Verbal and Math are consistently small and negative. This result suggests that these test scores arc not predictive of later efficiency and that high school grades are only slightly predictive. Interpreting these results must be tempered by the fact that they are based on graduates only and that UW is fairly selective in its regular admissions.

A most curious result is the pattern of correlations of GEI and the admissions index. All five correlation coefficients are small but statistically significant. However, the direction of the correlation is *negative* across all students and *positive* within each subgroup. How can this be? The answer lies in the inverse relationship between mean GEI and mean admissions index across the four groups. This relationship is illustrated in Figure 4, in which average AI and GEI are plotted on the same graph for each of the four groups. One can note that nontransfer B.A.-degree recipients have the highest average GEI but the lowest average admissions index as a group. In contrast, the transfer B.S. students have the lowest average GEI but the highest average admissions index as a group. The other two groups are intermediate but likewise in inverse order. In other words, the four pairs of means are nearly perfectly negatively correlated. Students who enter as freshmen and go into B.S. programs tend to be more capable upon entering college but also tend to take longer than those who go into B.A. programs. The relationship is also true for transfer students but it is moderated somewhat. Thus, within each group, the scatter plots have small positive slopes, but the scatter plot of group means is strongly negative. The latter causes the scatter plot of the data across all groups to have a small negative slope.

University of Washington Grade-Point Average (UW GPA)

The magnitude of the correlation of the GEI with UW GPA is considerably higher within the two nontransfer categories than within the transfer categories (.44 and .35 vs. .13 and .05, respectively). The variance of UW GPA is approximately equal for the four groups, thus these differences do not appear to be a restriction of range artifact. It is not clear at this point why higher grades appear to relate more strongly to higher efficiency for freshman admittees than for transfer admittees.

DISCUSSION

The graduation efficiency index (GEI), computed for each graduated student, is simply the ratio of the number of credits required for the degree minus the number of transfer credits divided by the sum of the enrollment census day credits in which that student has enrolled over the course of her education. In

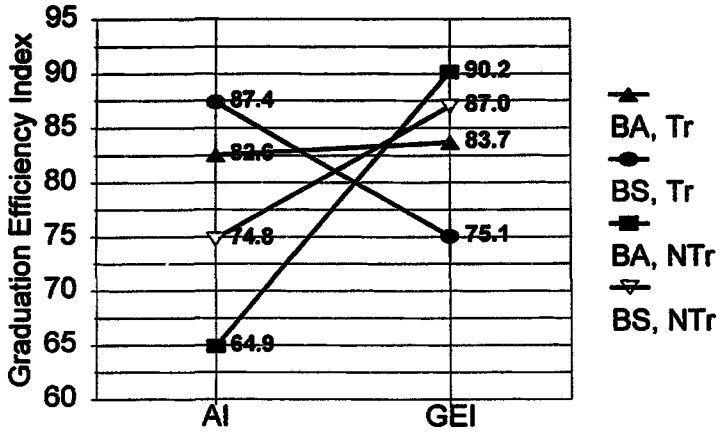

FIG. 4. Averages for GEI and Admissions Index within transfer and degree types.

this manuscript we have argued that as an accountability measure it is superior to calendar time from matriculation to graduation. Further, we have presented empirical results using the GEI as a dependent and correlational measure to demonstrate how the GEI can contribute to research that can increase understanding and guide efforts toward reducing inefficiencies in instructional resource consumption in obtaining degrees.

For the former, our argument is essentially that by far the most expensive aspect of college education is the cost of instruction, and the GEI is a simple but valid measure of students' use of this resource. In contrast, calendar time from when a student matriculates to when she graduates does not directly measure efficiency. The mere fact of a student taking more time to graduate does not necessarily adversely affect the number of students who can be educated. Examples of matriculated student behavior that does affect the number of students who can be educated within constant resources are taking above the minimum number of credits for the degree, dropping classes after another student can be added, and failing classes. These variables that affect efficiency are taken into direct account by the GEI.

If one accepts the GEI as a valid measure of efficiency, the moderate correlations between it and time to degree further call the validity of the latter into question. We found this correlation to be from $-.37$ to $-.48$ within subgroups. Time alone is a poor measure. Programs developed to reduce time alone might have some partial success in increasing efficiency, but they can be outweighed by negative consequences such as discouraging breaks in education to explore the world of work or participation in other maturing experiences and discouraging part-time students. For the latter, analyses indicate that part-time status is

related, though not strongly, to a lower GEI average. Because there is nothing inherent in part-time attendance leading to lower GEIs, this result requires further research to understand the underlying cause. Based on further probing, an institution might wish to discourage less than full credit loads, or it might alter a practice that causes lower GEIs and is associated with part-time attendance. In contrast, less than full credit loads inherently lead to greater time to degree and a focus on decreasing time to degree would be naturally drawn toward increasing full credit loads, per se.

The analyses above have offered several examples of uncovering areas of particular difficulty toward which to point efforts for improvement. The data indicated that B.S. degree awards are less efficient than B.A. degree awards. This result suggests a closer look at the relative GEI values of majors of different departments. We have done this analysis and have uncovered systematic differences that hopefully will lead certain departments to reexamine their curriculum and requirements.

The lower average GEI of transfer relative to nontransfer students suggests that articulation is less than perfect and may be a particular problem in four-year to four-year institutional transfer, but such an interpretation is surely only part of the story. Transfer students are different in some systematic ways from students who enter as freshmen. From research on this campus, we know that transfer students tend to work more and to lose more time with major changes (Gillmore and Basson, 1994). More pointed was the analysis that showed the average GEI of the B.S. degree awards to transfers was lower than the main effects of transfer status and degree type alone would predict. This result points to an area of difficulty not previously realized. One hypothesis is that transfer students are not adept at meeting prerequisites of their eventual B.S. degree while at the sending institution. B.A. degree programs tend not to be as tightly constrained by prerequisites—greater numbers of courses will serve to meet them. One reason for this discrepancy may be that prerequisite courses for certain physical science majors are not offered at community colleges due to the need for expensive laboratories. We are currently analyzing a sample of student transcripts to try to ascertain other reasons.

Perhaps the most dramatic result presented was the rapid lowering of GEI that is associated with transferring more than 90 credits. Students transferring more than two years worth of credits may graduate having taken relative few credits from the graduating institution, but more credits in all. Thus, this inefficiency as shown by our index is a greater problem from a system-level perspective than a local institutional perspective. Better advising or better articulation might improve the efficiency somewhat, but the overriding issue appears to be one of policy change. A simple solution from the institutional perspective would be to allow only 90 credits to be transferred. However, paradoxically, while this change in policy would likely increase the GEI at the institution, it

would likely detract from the efficiency at the state system level because more total credits would fail to count toward graduation requirements. Further exploration of this paradox may require taking the GEI to the next level by including transcript analysis of courses taken at the sending institution.

The analyses presented above indicate that admissions data generally poorly predict eventual GEIs. This lack of relationship is particularly evident for admissions test scores. One can view this result pessimistically—GEI is unlikely to be raised much by raising the quality of our students as measured by high school GPA and test scores. One can also view this result optimistically. There is nothing in the admissions data that limits the efficiency with which a student can move through the system. A more predictive personal variable may be the certainty with which students enter college in regard to their majors.

Efforts in two areas are underway that will allow expanded use of the GEI. First, the database upon which all analyses were performed consisted of 1993–94 graduates. Similar databases are being constructed for 1992–93 graduates and 1994–95 graduates. These data will allow us to try to replicate above results and to view the GEI's sensitivity to change.

Second, the State of Washington Higher Education Coordinating Board has accepted the GEI as one of the common accountability indicators, at the urging of four-year public institution provosts. Not only will this decision give the index more prominence, it will also assure its calculation and use at other institutions. Thus, cross-institution research will be possible. Furthermore, the fact that the use of the GEI was supported by the provosts of two research universities, three regional universities, and a nontraditional liberal arts college gives strong credence to its applicability across a wide spectrum of higher education institutions. Any institution granting degrees based on accumulation of course credits should be able to apply the GEI to issues on efficiency.

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NOTES

1. The statistics presented in this paragraph may obscure an important distinction between graduation rates and time-to-degree measures. The former refers to the proportion of an entering class cohort who graduate after a specified period of time. Thus, we can report a four-year graduation rate, a five-year graduate rate, etc. For example, 35% of the 1988 entering freshmen class graduated in four years. Time to degree, in contrast, is based on a cohort of students who graduated during a specified period. The time taken to attain the degree is retrospectively measured back to their date of entry. For example, the average time to degree of the 1995–96 graduating class is 4.5 years.
2. In directing our attention to graduation efficiency, we do not address the inefficiency that is generated by attrition. Needed are future efforts aimed at developing a comparable index for

nondegree completers, preferably one that can be combined with that associated with degree completers to show overall institutional efficiency. This point is addressed more fully in the "Limitations" section.

3. It is undeniably true that some "space" is more expensive than others, e.g., lab space versus lecture space. These concerns are beyond the scope of this paper but could be incorporated as a multiplicative factor in the formula to follow. However, so doing would change the measure from one of efficiency to instructional cost.
4. Normally, remedial courses—that is, courses deemed prerequisite to required courses but not counting toward graduation—would be counted as part of the enrollment credits. It might be tempting for institutions to suggest that remedial course credit not be counted as part of enrollment credits, thus assuring more comparability among institutions with varying commitments in that regard. However, not counting these credits denies the reality that some institutions should be less efficient that others by reason of their respective missions (see Trow, 1996, p. 5).
5. We include extension credits with transfer credits.
6. To see how these formulae differ, consider a student who transfers 90 quarter credits and who graduates with an additional 100 tenth-day quarter credits in a degree program that requires 180. The proposed GEI would calculate her index as [(180 − 90)/100] or 90%. The alternative version would calculate her index as (180/190) or 95%. In other words, each additional credit, over the minimum, subtracts more from the proposed GEI formula than from the alternative.

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