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ABSTRACT

The development of an inventory to measure self-regulated learning is reported. The first step involved the generation of an item pool based on a literature review. A pool of items was developed based on the five identified factors of metacognition, learning strategies, motivation, contextual sensitivity, and environmental utilization and control. A pilot version with 71 items was tested with 305 undergraduates, and one factor, self-regulated learning, was found to account for the largest portion of the variance. In the second version of the inventory, researchers began to construct a model of self-regulated learning in which to ground the construction of the inventory. This version was tested with 96 graduate students, but technical aspects were not entirely satisfactory. Version 3 represents an attempt to improve the technical properties of the inventory and an effort to clarify and sharpen the model. Version 3, which contained 4 subscales, was tested with 219 undergraduates and 62 graduate students. Reliabilities of this version were higher than those of the other versions, and all subscales and total score correlated with grade point average, with the motivation scale showing the strongest relationship. Results support the model and the potential of the inventory as a means of assessing self-regulated learning. (Contains 2 figures, 12 tables, and 14 references.) (SLD)

The design and development of the *Self-Regulated Learning Inventory*: A status report

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The construct of self-regulated learning has varied origins and flies under the banner of several theoretical frameworks. The basic issue addressed, however, is focused on the notions of volition and (internal) control. While not entirely ignored, these represent relatively neglected topics within the discipline of psychology, particularly learning related psychology. Nevertheless, a growing body of literature suggests that optimal academic performance is strongly tied to the degree of self-regulation the learner is capable of exercising (Borkowski, Carr, Rellinger & Pressley, 1990; Jones & Idol, 1990; Lindner & Harris, 1992b; Zimmerman & Martinez-Pons 1986; Zimmerman, 1990). Although the self-regulated learning perspective is not, at present, a theoretically unified one, according to Zimmerman (1990, p.4), "a common conceptualization of these students has emerged as metacognitively, motivationally and behaviorally active participants in their own learning." In other words, whether one espouses a social-cognitive, information processing or socio-cultural orientation, there nevertheless appears to be general agreement that self-regulated learners are purposive and goal oriented (proactive rather than simply reactive), incorporating and applying a variety of strategic behaviors designed to optimize their academic performance.

Self-regulated learners apparently control learning outcomes primarily from within; are intrinsically motivated, self-directing, self-monitoring, and self-evaluating. They also appear, however, to be more finely tuned than their less successful counterparts to situational demands, hence exhibiting greater flexibility in adapting to the variable and sometimes uncertain challenges that exist in the classroom, particularly at the high school and college levels. This is, at least, what the literature on the subject suggests. As such, they are likely to be highly able and motivated and, from an instructor's or teacher's perspective, desirable students. Our own interest in the construct of self-regulated learning emerged, in part, from the simple fact that our own classrooms appeared to contain very few learners that fit this description.

In general, our approach to the study of self-regulated learning has been to first seek to define, on the basis of the surrounding literature as well as our own investigations, the components of self-regulated learning as they are related to academic success (reflected, we presume, in such things as cumulative grade point average), collect data based on the models that emerged and then to attempt to define and capture the dynamics of the academic learning process from a self-regulated perspective. Our ultimate aim is to be able to apply our model diagnostically to assist students (our own as well as others) in achieving greater academic success. The model of self-regulated learning that has resulted from our effort thus far reflects primarily an information processing, control theory orientation.

One aspect of our overall effort toward shedding light on the process of self-regulated learning has involved use of the (evolving) model as the basis for generating items and subscales for a self-report, self-regulated learning inventory. Since self-regulated learning had been found to correlate significantly with academic performance (Zimmerman & Martinez-Pons, 1986, 1988), a cost- effective and efficient method of assessing for this important, if complex, variable could, we reasoned, prove to be a valuable device for both researchers seeking to illuminate this construct and for practitioners seeking to diagnose and remediate students whose learning is less than optimal. Description of our efforts in developing the inventory is the primary aim of what follows. The process, to date, has involved design and construction of the inventory and two major revisions. At present, based on evidence collected with the latest revision of our inventory, we appear to have an instrument that is both stable and respectable in terms of reliability and validity and which could prove useful to researchers and practitioners alike.

A Brief History of the Inventory

Version one. Our first step in the creation of the inventory involved the generation of an item pool. We began by reviewing the literature surrounding the construct of self-regulated learning. Our review suggested that self-regulated learning was a function of five factors: metacognition, learning strategies, motivation, contextual sensitivity and environmental utilization/control. We then proceeded to construct as many items related to these factors, and that reported strong relationships between learner generated activities and academic success, as we could. The result was a pool of approximately 100 items. We then reviewed and analyzed the items eliminating those that were too redundant and rewriting those that were either too complex or too vague. This left us with a pool of seventy-one items all of which were included in our first instrument. Although the items represented five subscales, we decided to present them randomly as a single test. A five point Likert scale format was chosen as most appropriate for this type of instrument.

A pilot run was subsequently conducted to see if directions were clear and sufficient, how long it took to respond to the inventory and if the items as written were clear and comprehensible. As a result, a formal set of instructions was composed. It was also determined that time to complete the inventory ranged from 20-30 minutes.

Findings of the first effort revealed reliability coefficients ranging from .83 to .64 for the subscales and a re-test reliability of .78 (see table 1). An exploratory factor analysis indicated that one factor (self regulated learning) accounted for the largest portion of the variance. In terms of validity, correlation between total score on the inventory and student gpa (see table 2) revealed a correlation of .54 ($p < .001$). Subscale scores were also found to correlate significantly with gpa (for more complete details see Lindner & Harris, 1992).

Table 1: *Reliability Coefficients*

	MCS	LSS	MOT	CSS	ECS
Alpha	.77	.83	.77	.64	.79

N = 160

MCS=Metacogntion scale   LSS=Learning Strategy scale   MOT=Motivation scale
CSS=contextual Sensitivity scale   ECS=Environmental Control scale

Table 2 *- Correlations: GPA and Scores on the Inventory*

	MCS	LSS	MOS	CSS	ECS	SRLTOT
	.41**	.47**	.48**	.31*	.39**	.54**

* p <.01, ** p <.001

Version two. Version one was only loosely grounded in theory. In version two we began to construct a model (see fig. 1) of self regulated learning in which to ground the construction of the

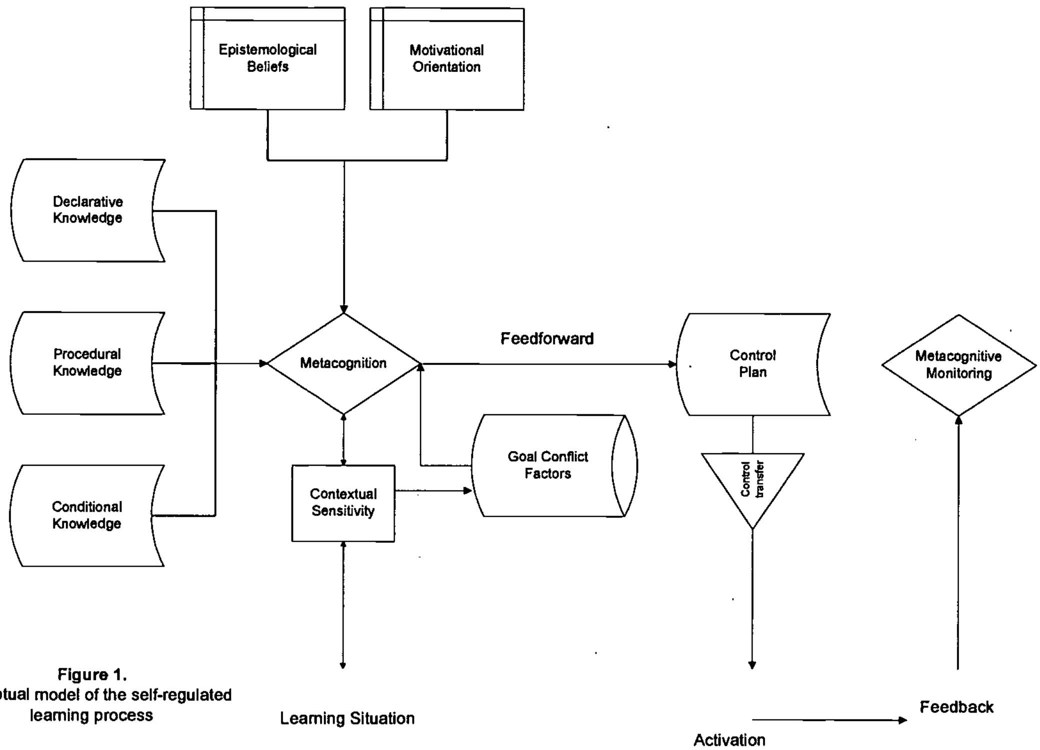


Figure 1.
Conceptual model of the self-regulated learning process

inventory. As a result of a continuing review of the literature and ongoing analysis of our own accumulating empirical data, we arrived at the conclusion that whether or not a learner is self regulating is best (most comprehensively) defined in terms of a complex interaction of five components: metacognition, learning strategies, motivation, contextual sensitivity and environmental utilization/control. Three of these (metacognition, motivation and environmental control) were based on the work of Zimmerman and Martinez-Pons (1986, 1988). The other components were derived from various strands in the literature related to self-regulated learning (Brown, 1987; Derry 1989; Dweck, 1989; Flavell, 1979; Nelson-Le Gall, 1985; Newman, 1990; Pressley, et.al., 1990; Perry, 1968; Schommer, 1990).

We further arrived at the working conclusion that metacognition, although mediated by, and dependent upon, the other components we had thus far identified, represents the key to self-regulation of the learning process. The reason for this decision lies partly in the definition of metacognition as the (more or less) conscious, executive (reflective, decision making) agent of cognition, and partly in the accumulating evidence reported in the research literature (Brown, et. al., 1983; Campione, 1987; Pressley et.al., 1990). With version two of our instrument, we also collected data on a graduate student sample for the first time.

The results of our revision, although partly successful, were also somewhat disappointing. Analysis of our graduate student data revealed a significant canonical correlation (.44, $p<.007$) between scores on the inventory scales and degree completion. This we considered an important success. We expected we would not obtain a significant correlation between scores on the inventory and gpa with this population due to the restricted range in gpa for graduate students. On the other hand, although a significant correlation between undergraduate gpa and the inventory subscales and total score continued to be evident, the strength of the relationship was not as strong as in our previous sample. Finally, the reliability of the motivation subscale looked questionable, particularly with regard to our graduate student sample. Our findings are summarized in tables 3 and 4.

Table 3 *Correlations of inventory scores with gpa for undergrad and graduate students*

	MCS	MOT	LSS	ECS	CSS	SRLTOT
UG	.29**	.26**	.22**	.18*	.27**	.30**
GR	-.19	.04	-.04	.03	-.02	-.06

* p< .01, **p<.001

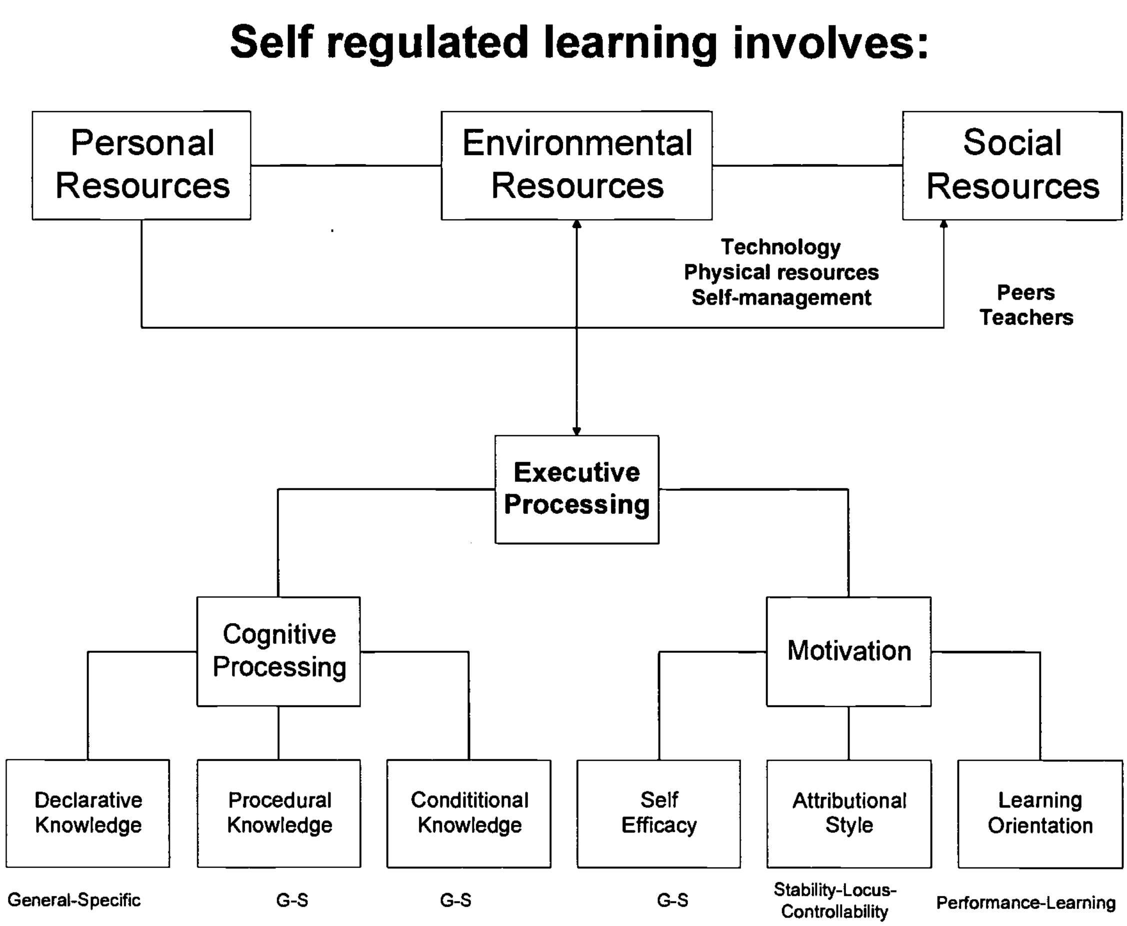
Table 4 *Reliability Coefficients (Cronbach's Alpha) on 5 subscales and total score on the inventory for undergraduate and graduate students*

	MCS	MOT	LSS	ECS	CSS	SRLTOT
UG *	.75	.63	.77	.80	.72	.91
GR **	.79	.30	.66	.52	.62	.86

*N = 305
**N = 96

Version three. Version three represents both an attempt to improve the technical properties of the inventory and an effort to clarify and sharpen the model upon which it is based. With regard to the model, we saw a need to clarify the meaning of different forms of processing involved and for a more focused differentiation between model components. The fact that constructs employed to describe cognitive processing as they exist in the contemporary literature are often confusing and contradictory is well documented (Alexander, Schallert, & Hare, 1991). Thus, for example, we saw the need to more clearly differentiate *executive* (metacognitive) processing and strategies from *cognitive* processing and strategies of a more automatized variety. The result of our attempt at refinement produced a (more parsimonious) model of self-regulated learning with four sub-components (executive processing, cognitive processing, motivation, and environmental control/utilization). The alert reader will have noticed that epistemological beliefs, part of a second version and model, has dropped out of the picture. Two reasons, neither of which are meant to suggest that epistemological beliefs are unimportant, led us to this decision. First, our data proved difficult to interpret with the inclusion of this variable and little significance to the overall result was contributed by the scores on this subscale. Second, we now think that this construct (epistemological beliefs) is probably too complex to measure with subscale of 15-20 items. Nevertheless, we do suspect that epistemological beliefs play a mediating role with regard to self-regulation and that the relationship between self-regulated learning and epistemological beliefs is in need of investigation. In any event, the inventory in its present form consists of four subscales reflecting our present working model of self regulated learning (see fig. 2). Each scale is comprised

Figure 2.



of 20 items, for a total of 80.

Method

Subjects. The current investigation (employing version 3 of the *Self-Regulated Learning Inventory*) was carried out at a medium sized university located in the midwest. It involved a sample of 281 students, all enrolled in courses in the college of education. There were 191 (68.0%) females, 81 (28.8%) males, and 9 (3.2%) who elected not to respond. The sample contained 248 (88.3%) Whites, 10 (3.6%) African American, 7 (3.2%) Hispanics, 2 (.7%) Asians, 2 (.7%) Native Americans, 6 (2.1) other, and 6 (2.1%) who did not respond. There were 219 (77.9%) undergraduates (1 freshman, 18 sophomores, 97 juniors, 103 seniors), and 62 (22.1%) graduate students, overall ranging in age from 19 years old to 53 years old, with a mean of 24.89 (sd=7.24) years old. The age range for the undergraduate students was from 19 yeas old to 46 years old, with a mean age of 22.71 (sd=4.82) years old; graduate students ranged in age from 20 years old to 53 years old, with a mean age of 32.5 (sd=8.96) years old. Their gpa ranged from a 2.00 to a 4.00; the mean gpa was 3.22 (sd=.53). Undergraduate students gpa ranged from 2.00 to 4.00, with a mean of 3.11 (sd=.50); graduate students gpa ranged from 2.50 to 4.00, with a mean of 3.72 (sd=.37). Over half (55.5%) of the students came from a rural setting (n=156), while 27.4% came from a suburban setting (n=77), and 13.9% from a urban setting; nine (3.2%) did not respond.

Procedure. The *Self-Regulated Learning Inventory V3.0* was administered in every case by one of the three researchers in a variety of courses offered in the college of education. A standard set of instructions was read to intact classes who then completed the inventory as instructed. Each item is responded to on a 5-point Likert scale ranging from *Almost always typical of me* (5) to *Not at all typical of me* (1). To help prevent students from simply marking all fives, a number of items on each scale were negatively worded. These items were recoded in the data analysis so that a 1 became a 5, a 2 became a 4, 3 stayed a 3, 4 became a 2, and a 5 became a 1. This resulted in that each factor had a range of scores from a low of 20 to a high of 100; the total self-regulated learning (SRLTOT) scale ranged from a low of 80 to a high of 400. Completion of the inventory was strictly voluntary, though in some of the undergraduate classes the students were given one extra credit point for participating in the study.

Results

Our findings are presented in summary form as follows: summary statistics for graduate and undergraduate students are presented in tables 5 and 6. Tables 7, 8 and 9 contain the

Table 5: *Summary descriptive statistics for undergraduate students*

Variable	Mean	Std Dev	Minimum	Maximum
GPA	3.11	.50	2.00	4.00
AGE	22.58	4.97	19	46
EXPS	66.35	10.13	39	97
COGS	68.24	9.48	39	93
MOTS	71.24	9.13	48	92
ECUS	64.41	11.28	30	93
SRLTOT	270.09	33.37	185	367

N = 218

Table 6: *Summary descriptive statistics for graduate students*

Variable	Mean	Std Dev	Minimum	Maximum
GPA	3.72	.37	2.50	4.00
AGE	32.52	8.96	20	53
EXPS	69.75	10.98	45	98
COGS	74.40	9.92	36	90
MOTS	74.88	8.15	52	93
ECUS	69.10	11.37	45	93
SRLTOT	287.46	34.71	187	369

N = 62

Table 7: *Reliabilities (Cronbach's alpha) for Inventory and subscales (all subjects)*

Scale	**alpha**	**N**
EXPS (executive processing)	.83	275
COGS (cognitive processing)	.82	272
MOTS (motivation)	.78	273
ECUS (environmental utilization/control)	.83	276
SRLTOT (total score)	.93	267

Table 8: *Reliabilities (Cronbach's alpha) for Inventory and subscales(undergraduates)*

Scale	**alpha**	**N**
EXPS	.82	215
COGS	.80	217
MOTS	.78	215
ECUS	.82	215
SRLTOT	.93	210

Table 9: *Reliabilities (Cronbach's alpha) for Inventory and subscales(graduate students)*

Scale	alpha	N
EXPS	.86	60
COGS	.85	60
MOTS	.75	58
ECUS	.84	61
SRLTOT	.94	57

reliabilities (Cronbach's alpha) of the inventory and subscales for undergraduates graduate students and both groups combined. By comparing tables 1 and 4 to tables 7-9, it can be seen that reliabilities are at their highest and most consistent in the latest version of the inventory. Furthermore, all four subscales appear to be reliable at acceptable levels for both graduate and undergraduate students.

Tables 10, 11 and 12 provide a summary of inventory scores and grade point average for undergraduates, graduates and the two groups combined. It can be seen that all subscales and total score correlate significantly with gpa with motivation showing the strongest relationship. Surprisingly, even though our graduate sample is relatively small and the range for gpa is highly restricted in this group, two subscales (EXPS and MOTS) and total score nevertheless show a significant correlation with grade point average.

Table 10: *Correlation for Inventory and subscales(undergraduates) with gpa*

Scale	Mean	gpa	N
EXPS	66.31	.17**	210
COGS	68.19	.24***	212
MOTS	71.19	.44***	210
ECUS	64.38	.19****	210
SRLTOT	270.09	.30***	205

** $p < .01$; *** $p < .001$; **** $p < .005$

Table 11: *Correlation for Inventory and subscales (graduates) with gpa*

Scale	Mean	gpa	N
EXPS	69.75	.28*	46
COGS	74.40	.15	47
MOTS	74.88	.31*	46
ECUS	69.10	.22	47
SRLTOT	287.46	.32*	45

* $p < .05$

Table 12: *Correlation for Inventory and subscales(all subjects) with gpa*

Scale	Mean	gpa	N
EXPS	67.07	.23***	256
COGS	69.54	.31***	259
MOTS	71.97	.46***	256
ECUS	65.42	.26***	257
SRLTOT	273.79	.37***	250

*** $p < .001$

Discussion

These results appear to lend support both to our model and the potential of the inventory as a means of assessing self-regulated learning. However, despite the fact that the relationship between scores on the inventory and academic performance is clearly statistically significant, the strength of that relationship, indicated by the correlations, is, at best, modest. This remains the case despite the fact we have clear indication that the scales are now reasonably reliable. Several factors suggest themselves as possible explanations. Most obviously, factors other than those we have been able to capture are playing a role in determining academic success. Such factors may include such things as general intellectual ability as well as differences in domain-specific knowledge. Perhaps despite similar learning and metacognitive skills (or strategies), some individuals simply use them more effectively. On the other hand, greater familiarity with concepts and procedures within a particular domain are known to affect performance (Bruer, 1993). We believe, however, that despite the potential impact of such factors, that the answer lies as much outside of the student as within. That is, after many years of schooling, most students (in order to have come this far) will have successfully adapted to the demands of academic life and, thus, their strategies and attitudes will reflect the nature of the demands that academic tasks have placed upon them. Those that succeed will, we believe, be self-regulating - but not in the sense we have been most interested in. That is, we have been working with the assumption that metacognition (conscious and deliberate monitoring, evaluating, and making of critical and adaptive decisions, etc.) is crucial to (even definitive of) self-regulated learning. Surely some metacognitive (executive) processing is necessary for academic success. We suspect, however, with the possible exception of the graduate students in our sample, that what determines (that is, is sufficient for) academic success for most students are two factors: high motivation and a modest repertoire of "proven" learning tactics applied to classroom demands without considerable metacognitive effort. To test our hunch we conducted a stepwise multiple regression analysis using the inventory subscales and total score as predictors of gpa. The results with all four subscales and total scores entered stepwise leaves only motivation in the equation ($R = .43$, $p < .0001$). However, when all subscales and total score are entered leaving motivation out, all factors remain in the equation ($R = .47$, $p < .0001$). Our interpretation is that although all the subscales correlate significantly with gpa, motivation is mediating the other factors. The second most important factor appears to be cognitive processing. This result is most clear in the undergraduates in our sample. It remains possible, of course, that our results apply only to our particular sample. This bears further investigation (I should note that one such investigation is currently underway in the form of a doctoral dissertation).

Conclusions

For the past five years we have sought to investigate the nature of academic success in college students by investigating the kinds of skills, knowledge, beliefs and attitudes they bring to the task of academic learning. A major portion of our effort has focused on the design and development of a self-regulated learning inventory. Our results indicate that self-regulated learning is a meaningful and measurable construct which is clearly related to academic performance. Furthermore, results indicate that our instrument and the model upon which it is based represent a workable framework for exploring and assessing, and perhaps remediating, academic learning. Validity of the findings based on responses to the inventory is attested to by the consistently significant correlation with gpa over all three versions as well as the significant relationship between scores on the inventory and degree completion in graduate students. Because the subscales allow one to identify specific strengths and weaknesses in a student's approach to learning, specific remedies can be designed to improve the learning process in a given individual, we believe, the ultimate value of the inventory, however, lies more in its diagnostic potential than in the mere fact that a significant relationship between scores on the inventory and academic performance exists.

The fact that inventory scores are significantly related to gpa is encouraging. However, the reliability of gpa is a matter that has received little attention. It is common practice for investigators to attend more fully to the reliability of predictor scores than criterion variables. We suspect that with error removed (in both criterion and the instrument) the relationship between self-regulated learning (as defined in our framework) would be stronger, but this claim remains to be substantiated. In any event, one of our aims has been to develop an efficient, reliable and valid means of assessing students for the degree self-regulated learning related behaviors they exercise. Present findings appear to represent significant progress along this route indeed offering researchers and practitioners a reliable instrument for assessing and exploring the construct of self regulated learning .

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