Comprehensive Problem-Solving and Skill Development for Next-Generation Leaders

Ronald A. Styron, Jr.
University of South Alabama, USA

Jennifer L. Styron
University of South Alabama, USA

A volume in the Advances in Business Strategy and Competitive Advantage (ABSCA) Book Series

www.igi-global.com

Published in the United States of America by
IGI Global
Business Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Styron, Ronald A., 1954- editor. | Styron, Jennifer L., 1980- editor.
Title: Comprehensive problem-solving and skill development for next-generation leaders / Ronald A. Styron Jr. and Jennifer L. Styron, editors.
Description: Hershey : Business Science Reference, [2017]
Identifiers: LCCN 2016049581| ISBN 9781522519683 (hardcover) | ISBN 9781522519690 (ebook)
Subjects: LCSH: Leadership--Study and teaching. | Problem solving--Study and teaching.
Classification: LCC HD57.7 .C6487 2017 | DDC 658.4/092--dc23 LC record available at https://lccn.loc.gov/2016049581

This book is published in the IGI Global book series Advances in Business Strategy and Competitive Advantage (ABSCA) (ISSN: 2327-3429; eISSN: 2327-3437)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 11
Leadership for Improving Student Success through Higher Cognitive Instruction

Russell Jay Hendel
Towson University, USA

ABSTRACT

This chapter distinguishes between a shared hierarchical leadership, where a leader formulates goals, identifies training materials, authorizes funds and then all participate in a shared culture, vs. a fully shared co-leadership, where all educational stakeholders co-lead by initiating innovation and sharing development. This chapter advocates fully shared co-leadership. The key contribution of this chapter is the identification of four key attributes of higher cognitive pedagogy: executive function, attribution theory, goal-setting, and self-efficacy. These four attributes can easily be mastered by all educational stakeholders: mentors, principals, instructors, tutors, and students. Consequently, this chapter advocates the initiation of educational innovation in pedagogic delivery by instructors. The chapter illustrates its approach with a diverse set of subjects ranging from mathematics to essay writing. A typical application presented in this chapter illustrates spontaneous leadership at the university level followed by a more structured collaboration with K-12 institutions.

INTRODUCTION

Leadership

Leithwood, Jantzi and Steinbach (2009) distinguish four categories of transformational educational leadership:

- Setting directions, collaborative practices and high expectations.
- Developing the knowledge, skills and values of people by stimulating, supporting and modeling professional practices and values.

DOI: 10.4018/978-1-5225-1968-3.ch011

- Redesigning and strengthening the school culture organization.
- Managing instructional programs.

This chapter focuses on the last category, instructional leadership. Instructional leadership seeks to facilitate growth in student learning. An instructional leader reforms approaches to teaching by orienting staff to ambitious instruction methods (Cobb, 2008). To effectively lead instructionally, the leader must be a master of a range of pedagogical practices that promote learning, and focus on educational methods rather than on educational content (Hopkins & Harris, 2000; Hopkins, Harris, & Jackson, 1997).

Instructional leadership is best achieved by distributed leadership in a shared culture. A sharing instructional leader shares and distributes his or her responsibilities by advocating open communication and collaboration (Parsley, 2009). Sharing educational leaders create conditions that enable teachers and students to take a high degree of responsibility for their own teaching and learning (Duignan, 2006). The sharing takes place at several levels including decision-making, teamwork and work assignment (Cordeiro & Cunningham, 2013). Harris (2008) points out that shared leadership can be recognized by seeing leadership in many more people in the organization than just those with titles.

Using the leadership concepts just introduced, two forms of shared instructional leadership can be formulated which this chapter calls hierarchical shared leadership and fully shared co-leadership.

- The hierarchical instructional leader leads his or her group by providing new and ambitious forms of pedagogical instruction, sharing both the vision and details with his or her group which then forms a team for implementing the idea. Thus, the leader's leadership is expressed by selecting the pedagogical innovations, methods and training to focus on. The leader is possibly also responsible for funding.
- Contrastively, the fully shared instructional leader has a less dominant role. New ideas of pedagogy may be initiated by any member of the group working with the leader. The group as a whole still works as a team to develop the idea. Thus, the leader's leadership is not expressed through idea selection or idea implementation; rather, leadership is at most expressed by presenting the idea, facilitating development of the idea, or by researching and providing resources for the idea's implementation. An alternative formulation is that all team members are equal co-leaders with perhaps one of them initiating the idea.

The transition from a hierarchical instructional leadership in the direction of a fully shared co-leadership is illustrated by the GOGYA project of the AMIT network of schools in Israel (Chabin, 2015). Prior to GOGYA, AMIT, a network of roughly 110 high-schools in Israel with a centralized leadership, had used a hierarchical shared instructional leadership. Each of the principals in the 110 schools had mentors who would help coach and disseminate ideas and methods of pedagogy. The mentors in turn took direction from the centralized leadership.

The GOGYA project has facilitated transformation in the direction of a shared instructional co-leadership. As Deutsch, coordinator of research and development (R&D) for AMIT, states, "We are building leadership. We do not want to send mentors to schools forever. Eventually, we want the teachers to lead themselves" (Chabin, 2015, p. 13).

The basic GOGYA idea is that the R&D team from each school, a group of seven teachers, travels to the GOGYA site once a month. There they listen to lectures on pedagogy, methods and resources, but more importantly, they share with each other. Upon returning home, they share with other instructors in

their own schools. The emphasis is on activity-based learning including project-based learning and open-ended exploration. GOGYA defines the needs of students as follows: "What students need are teachers who encourage them to seek out information, individually or in groups, teach them the tools to interpret it, and take this information in exciting and fun directions" (Chabin, 2015, p. 10). GOGYA defines the needs of teachers as follows: The teachers must have "the ability to enact change in their schools. They need to learn how to collaborate with other teachers to teach interdisciplinary subjects. And once they learn these things they need to learn how to assess the results of this new type of learning without using a conventional exam" (Chabin, 2015, p. 12).

Consequently, GOGYA "is a place to study, for groups [of teachers] to collaborate for peer study, for groups to develop new methodology and pedagogical ideas" (Chabin, 2015, p. 10). "GOGYA is a comprehensive cultural change. Rather than change one piece of a puzzle, it deals with all of a school's components from the method of teaching and assessment to how to organize daily life at the school and which programs to teach, and how" (Chabin, 2015, p. 11). "Although the principal will always have the final say on matters related to his or her school, we want teachers to be empowered and to share the great ideas they have" (Chabin, 2015, p. 13). The article summarizes the change as follows: "Before GOGYA the innovation came from the top down, not the bottom up" (Chabin, 2015, p. 13).

Educational Organization

To discuss educational innovation, both leadership and educational organization must be understood. AMIT achieved its successes by using organizational structures known to ensure amelioration of educational gaps between socio-economically deprived and richer groups. In fact, by design, 70% of AMIT's network is in rural socio-economically deprived areas.

The principles of organization for assuring success in ameliorating gaps are described by Clark (2014). By studying educational organization in all seven continents, Clark (2014) was able to summarize key features needed to ameliorate gaps in science, technology, education and mathematics (STEM). Those countries that have been very successful in shortening gaps – countries like Korea, Finland and Singapore – approach educational organization using the following organizational attributes (Hendel, 2014b):

- **Uniform Curriculum:** The school system uses one set of curriculum standards emphasizing higher order thinking.
- **Uniform Assessment:** Upon completion of all studies, the school system tests all students using a uniform examination, emphasizing higher order thinking skills. The results of this examination are a critical requirement for entrance to college. This structure assures more equal access to college for all students.
- **Uniform Oversight:** The entire school system is overseen by a central organization that preserves standards, sets goals, and provides incentives for high quality teachers in socioeconomically disadvantaged areas. These incentives may take the form of, for example, higher salaries, bonuses, promotion opportunities and smaller class sizes.
- **Teachers:** Teachers are:
  - Treated as professionals.
  - Provided with mentors and adequate tutors.
  - Provided with educational opportunities such as links with universities.
  - Have majors in their field of teaching and several certifications.

This Chapter's Contribution

The preceding discussion gives the necessary background on leadership and organization needed to describe this chapter's goals with more precision. This chapter assumes five educational stakeholders in the teaching process:

- Principals,
- Mentors,
- Teachers,
- Tutors, and
- Students.

This chapter also assumes clearly set and uniform curriculum objectives. However, while the goals of the curriculum are fixed, the delivery methods for reaching these goals are not fixed. Such a setup allows, and even invites, pedagogic innovation in educational delivery methods.

Against this background, this chapter's main contribution is the presentation of four, deep, underlying characteristics of higher cognitive pedagogy. Throughout this chapter, the term driver is used to refer to a deep underlying attribute that drives a concept being discussed.

Each of these four educational drivers can be mastered quickly in a short time. Thus, all stakeholders in the educational process, the principals, mentors, teachers, tutors and students, equally have the tools necessary to assess proposed educational projects. This equality of access to the tools needed for assessment of pedagogic projects strongly facilitates a shared culture where all can work and lead together.

This chapter advocates a fully shared co-leadership approach towards certain types of pedagogic innovation. As will be illustrated in the Application section below, if an instructor has an idea for innovative pedagogic delivery, and if that idea strongly satisfies the criteria of at least one of the four educational drivers, then that instructor can immediately initiate co-leadership in the project for developing the idea; typically, the project can modestly begin without need of extensive training or approval. In an electronic age, it is possible to form a team of instructors who co-lead in a shared environment to fully develop the idea. The examples presented in the Application section amply illustrate this. The methods of this chapter are more easily initiated in a college or university setting; however, theoretically, they are transferrable to K-12 settings. Several of the examples in the Application section illustrate initiation and development at the university level with consequent partnership at the K-12 level.

This chapter also advocates fully shared co-leadership as a supplement to other styles of instructional leadership. A project initiated using fully shared co-leadership may become so broad that it requires funding, approval and a variety of logistics. In such a case, the project is initiated with fully shared co-leadership and later develops using hierarchical shared leadership. The Application section presents examples. By presenting the four educational drivers, this chapter facilitates sharing leadership at all levels.

THE FOUR EDUCATIONAL DRIVERS

The four educational drivers presented in this chapter are:

- Executive function.

- Goal-setting, also known as measurability.
- Attribution theory.
- Self-efficacy.

Each driver is briefly explained below. The Background and Application sections illustrate how these drivers drive higher cognitive pedagogy.

Executive Function

Executive function refers to the brain function that allows a person to simultaneously use and integrate several other brain functions. There are many aspects to executive function, including, for example,

- Organization,
- Working memory,
- The ability to focus or direct attention to selected items but ignore others, and
- The ability to change one's perceptions of patterns (Pickens, Ostwald, Murphy-Pace, & Bergstrom, 2010).

There are many different tests of executive function. Two broad classes of tests are open-ended executive function tests and performance executive function tests (Toplack, West, & Stanovich, 2013). Open-ended tests assess a person's capacity to deal with a new situation that is not solvable by traditional methods; for example, asking a person what he/she would do if he/she found, while on a vacation, that he/she had forgotten an important medication.

Contrastively, performance executive function tests assess performance in an examiner's office. The performance tests present contrived, not real world, scenarios in a tightly controlled manner in order to assess the examinee's executive function. The basic theme explored by any performance test is the ability of the examinee to predict outcomes as a (Boolean) logical function of multiple brain areas (Hendel, 2015b). For illustrative purposes, a simple executive function test, the Trail Making test is presented (Bowie & Harvey, 2006). The Trail Making test consists of two parts, Part A and Part B. (The description of the tests has been modified for illustrative and pedagogic purposes.)

- In the Part A test, the examiner presents a sequence of numbers, for example, 2, 1, 4, 3. The examinee must make a trail connecting the numbers in sequence. Using the sequence 2, 1, 4, 3 and indicating choices with parentheses, the examinee would sequentially respond as follows.
  - 2, (1), 4, 3
  - (2), 1, 4, 3
  - 2, 1, 4, (3)
  - 2, 1, (4), 3

The time the examinee takes to make the trail through the numbers in sequence is recorded.

- In the Part B test, the examiner presents a sequence of numbers and letters, for example, A, 1, B, 2. The examinee must make a *trail* connecting the numbers and letters in a mixed numerical-al-

phabetical sequence, for example, 1, A, 2, B. Using the sequence A, 1, B, 2 and indicating choices with parentheses, the examinee would sequentially respond as follows.

- A, (1), B, 2
- (A), 1, B, 2
- A, 1, B, (2)
- A, 1, (B), 2

The time the examinee takes to make the trail through the numbers and letters in sequence is recorded.

Certainly, the two tests' tasks are easy to perform. Nevertheless, the Part B test typically, for any individual examinee, takes longer than the Part A test. The difference in times to complete the trails in the two tests is an important measurement. For example, the difference in times correlates highly with intelligence and brain impairment (Corrigan & Hinkeldey, 1987; Reitan, 1958). The power of the Trail Making test is attributed in part to its executive function quality (Gaudino, Geisler, & Squires, 1995). Despite the simplicity of the tasks in the Part A and Part B test, the Part A test, uses one brain area, the area dealing with numbers, while contrastively, the Part B test uses two brain areas, the areas dealing with numbers and letters. This multiplicity of areas is the defining characteristic of executive function.

The idea that executive function is an education driver is simply explained. Both the National Council of Teachers of Mathematics (2000) as well as the Common Core State Standards (Kendall, 2011) advocate pedagogy based on multiple modalities or representations of subject matter, that is, based on executive function.

Goal-Setting, Measurability, Specificity

Goal-setting refers to how a complex task is broken into component tasks. When breaking down a complex task into component tasks, best learning and performance are attained when the component subtasks are

1. Specific,
2. Challenging,
3. Realistic, and
4. Attainable in a short time (Lenz & Shortridge-Baggett, 2002; Locke, Shaw, Saari & Latham, 1981).

In such a case, one can say that the component tasks are *measurable* or *specific*. The mnemonic traditionally used for describing such a componential analysis is S.M.A.R.T:

- *S*pecific,
- *M*easurable,
- *A*ttainable,
- *R*ealistic, and
- *T*imely achievable.

A discussion on terminology is warranted. The word "measurability" and even the mnemonic S.M.A.R.T. are inadequate. There is no single word in English capturing the multiple nuances of measurability or goal-setting, which includes both the quantification of an educational goal as well as the qualitative breakdown of a complex educational skill into several component subtasks, goals, or skills.

The term measurability seems to have been popularized in the assessment for learning (AFL) literature (Black, Harrison, Lee, Marshall, & Wiliam, 2003; Black, Harrison, Lee, Marshall, & Wiliam, 2004; Black & Wiliam, 1998). A literature review of several hundred papers showed that the use of specific learning objectives (SLO) based on specific, measurable, curricular items significantly increases learning. However, a close examination of the examples shows that the emphasis is not on measurability in the sense of raw counting, but rather on specificity and challenge. In other words, measurability is used to indicate tasks that are

1. Specific,
2. Realistic,
3. Challenging, and
4. Achievable in a short time period.

Notice, that challenge is not included in the S.M.A.R.T. mnemonic. There is not even universal agreement on what the letters in S.M.A.R.T. stand for; for example, the "t" could stand for task-difficulty. In fact, Locke and Latham (1990) add five other attributes for best goal-setting:

- Clarity,
- Challenge,
- Commitment,
- Feedback, and
- Task complexity.

To avoid the ambiguities in these multiple approaches, throughout this chapter, the term goal-setting will be used.

To illustrate many aspects of measurability, a series of well-designed experiments attempting to improve dart-throwing skill (Kitsantas & Zimmerman, 1998, 2002; Zimmerman & Kitsantas, 1996, 1997) is presented below. The educational goal instructed to the dart throwers was formulated to trainees in five distinct ways. The experiments showed that certain formulations produced poorer results while others produced better results. Here, "better results" refers to increased:

1. Scores,
2. Skill competency (in dart throwing),
3. Student satisfaction,
4. Student interest, and
5. Student self-efficacy, a psychological attribute indicating confidence that one can achieve a goal with ones' given skills.

The five educational goals used in the dart throwing experiments are presented in Table 1. Dart throwers who were instructed to achieve the goals listed earlier in the table achieved lower scores than the dart throwers who were instructed to achieve the goals listed later in the table. For example, dart throwers instructed to achieve process goals performed better than those instructed to achieve outcome goals. Note that the author of this chapter changed the names of several goals. Thus *outcome goal* was changed to *outcome goal without further specificity*; *transforming goal* was changed to *feedback goal*

Table 1. Five goals given to dart throwers in the dart-throwing experiments

Name of Goal	Students Were Instructed to Do the Following Goal
No goal	Practice throwing darts (no further instruction on goals was given).
Outcome goal without further specificity	Achieve the highest score possible.
Process goal with specificity	In each dart throw, carefully attend to using three steps: i) goal sighting, ii) achieving a throwing position, and iii) follow-through (actual throwing).
Feedback goal	In each dart throw, try to correct relative to the previous throw. For example, if the previous throw was too far to the left of the goal, the current attempt should attempt to compensate for that.
Two-stage goal	First, achieve mastery in using the following three steps: goal sighting, achieving a throwing position and follow-up. Upon achieving this mastery, attempt to achieve the highest score possible.

and *shifting goal* to *two-stage goal*. These changes in description of component goals are consistent with the modern terminology on goal-setting discussed above. Table 2 clarifies some aspects of goal-setting illustrated by the dart-throwing experiment.

Note that goal-setting requires executive function to integrate the component skills. Thus, whenever goal-setting is present, executive function is present as well. However, they are different educational tools:

- Goal-setting facilitates creation of individual subtasks,
- Executive function facilitates the holistic integration of components into a whole.

Attribution Theory

Roughly speaking, attribution theory studies how an individual explains successes and failures; in other words, attribution theory classifies the causes that a person attributes to success or failure. Four typical attributions of success and failure are:

Table 2. Aspects of goal-setting illustrated by the dart-throwing experiment

Aspect of Goal-Setting	Comments on Effectiveness
Lack of measurability and specificity	The *no-goal* group performed the poorest and had lowest self-efficacy. Clearly, some type of measurability is needed to achieve educational excellence.
Numerical measurability	The *outcome goal* was to achieve the highest score, a *numerical* measure of student success. The outcome-goal group did better than the no-control group, but poorer than the other groups. While numerical measurability improves outcomes, numerical measurability by itself is not sufficient to assure success.
Qualitative measurability	The *process goal group* focused on the component skills necessary to achieve the dart throwing. This breakup into component skills may be called measurable since the goal is broken into three distinct component skills. However, as noted above, the emphasis is not on counting, but rather on specific, realistic, challenging tasks that are achievable in a short time period.
Hierarchical measurability	The *two-stage goal group* combined the quantitative and qualitative goals in a hierarchy. The qualitative goals had three component skills, goal sighting, achieving a throwing position and follow-up, while the quantitative goal, to achieve the highest score, formed a separate stage.

Table 3. Three dimensions or drivers of success and failure used by attribution theory

Dimension of Success or Failure	Value of Dimension	Examples
External/Internal	Driver is *external* to the person.	I failed because the instructor didn't like me.
External/Internal	Driver is *internal* to the person.	I succeeded because I worked; I succeeded because I am a genius; I failed because I am a failure.
Stable/Unstable	Driver is *stable* and will remain the way it is.	I succeeded because I am a genius; I succeeded because everyone knows my family name.
Stable/Unstable	Driver is *unstable*; it must be maintained or it will go away.	I succeeded because I worked.
Controllable/ Uncontrollable	The person can *control* the cause of success or failure.	I succeeded because I put in five hours of effort.
Controllable/ Uncontrollable	The person can *not control* the cause of success or failure.	I failed because the teacher created such a hard test that even if we had unlimited time and access to the class texts, we couldn't have passed it.

1. Luck,
2. Ability,
3. Effort, and
4. Task difficulty.

Several researchers in different areas have rediscovered attribution theory (Dweck, 1986; Orbach, Singer, & Price, 1999; Weiner, 1985).

Attribution theory presents three primary dimensions to describe drivers of success or failure. Table 3 summarizes these dimensions, their meanings, and provides illustrative examples.

Attribution theory is still in its infancy and more research is needed. Researchers do not always agree. One fundamental contribution of attribution theory is that the most efficacious attribution of success is an internal, unstable, controllable attribution. The paradigm internal, unstable, controllable attribution perceives success to be due to the amount of work and effort placed by the person in preparing for the successful event. Effort and work belong to the following dimensions:

- Effort and work are internal since the individual does it.
- Effort and work are unstable since their effect will vanish if the work or effort stops. This is contrastive to, for example, innate ability, which is a stable feature of a person.
- Effort and work are controllable, since the individual can increase (or decrease) the effort and work put into a task.

Attribution theory is an important driver for self-efficacy, a person's conception of his or her capacity to integrate and use their current skills to accomplish a task. Self-efficacy is examined later in this section.

It is important to contrast attribution theory with executive function and goal-setting.

- Executive function and goal-setting are important in syllabus or curriculum construction. One can examine the syllabus or curriculum and ascertain whether multiple brain areas are addressed and whether complex tasks are broken up into S.M.A.R.T., challenging, component tasks.

Table 4. Three evaluation treatments of student homework in identically taught courses

Evaluation Treatment	Brief Explanation	How this Evaluation Method Is Perceived by the Student
Grades	One group was simply given letter grades.	The grade is something external to the student; the grade is given as is without explanation of why the grade was earned; the grade reflects the instructor's opinion.
Comments	One group was simply given comments, an explanation of why certain parts of the student work were good and why certain parts of the student work were not good. Comments included recommended steps to improve.	Contrastive to the letter grade, the comments are exclusively internal and controllable. The comments reflect universal standards. Their implementation can be done by the students (controllability).
Grades and comments	Both a letter grade and comments explaining what is good and bad and how to improve were given.	Although the comments reflect universal standards, the grade reflects the instructor's perception of seriousness of these standards. Hence, the evaluation is perceived as external.

- Contrastively, attribution theory is important in assessment and encouragement of students. It deals with how a student perceives successes and failures rather than with the course content.

Butler (1988) presents the following pedagogic example, illustrative of application of attribution theory. Three evaluation treatments were given to three classes studying the same subject. These treatments are presented in Table 4. Attribution theory predicts that the internal controllable attribution affects performance the best, and indeed, the students receiving comments without letter grades improved in performance the most since the evaluation comments were not a grade from an external source but rather recommended specific activities for students to improve (internal, controllable and stable).

Self-Efficacy

19th century psychological theory held that unconscious drives and desires determined behavior. Contrastively, modern social cognitive theory holds that people are agents who can determine their own behavior. Central to social cognitive theory is self-efficacy (Bandura, 1977, 1997, 2000, 2001).

Self-efficacy is a person's belief that he/she can organize and integrate his/her current skills to achieve certain goals. It is a specific form of confidence, the belief that certain tasks the person performs will lead to desired goals. Self-efficacy should not be confused with certain related items, such as a person's aspirations and hopes or a person's awareness of his/her skill sets. Self-efficacy is more than the belief that a person can succeed; rather, it is the belief that one can organize and integrate one's current skills and knowledge to perform or succeed at a given task.

Self-efficacy is important because it is "the core agentic factor that determines people's goal directed behavior" (Feltz, Short, & Sullivan, 2008, p. 5). For example, knowledge of self-management skills in diabetic patients does not predict success in self-management; however, in the majority of patients, self-efficacy does predict success in self-care (Lenz & Shortridge-Baggett, 2002). Self-efficacy is the primary determinant of people's levels of motivation to accomplish a specific goal. A high level of motivation is especially needed in complex problem solving since without motivation, problem solvers give up.

Self-efficacy and its drivers are well understood. Self-efficacy is widely used in a variety of areas, for example, sports skill acquisition (Feltz et al., 2008) and acquisition of self-management skills by the

sick (Lenz & Shortridge-Baggett, 2002). A proper application of self-efficacy to educational settings requires understanding its drivers.

Bandura (1977, 1997, 2000, 2001), the founder of social cognitive theory, listed four primary drivers of self-efficacy. Maddux (1995) and Schunk (1995) supplemented these four drivers with two more. Not all six drivers are equally important. The most important driver of self-efficacy is previous performance successes. Vicarious experiences and verbal persuasion are also important, but play a secondary role. The other drivers play a tertiary role. Self-efficacy increases the most when drivers are combined (Feltz et al., 2008; Lenz & Shortridge-Baggett, 2002). The six drivers for self-efficacy are presented in Table 5.

BACKGROUND

Current Pedagogical Theory

Starting in the latter half of the 20th century, pedagogic theory blossomed from the traditional emphasis on memorization of facts and methods to a new approach based on educational hierarchies such as those of Bloom (1956), Gagne (1985), Van Hiele (1986), Marzano (2001), and Anderson and Krathwohl (2001). All the educational hierarchies list several levels of pedagogic challenge; the hierarchies all distinguish in some way between raw memorization of facts and higher cognitive thinking.

Table 5. The six drivers of self-efficacy with brief explanations

Driver of Self-Efficacy	Brief Explanation
Performance accomplishments	The more successes one has had, the greater one's self-efficacy in future successes; the influence of pass successes on self-efficacy is a function of i) performance difficulty, ii) the effort expended, and iii) the amount of guidance needed. Performance accomplishments can also be facilitated by guided coaching.
Vicarious influences	Self-efficacy is strengthened through observation and comparison with others. Vicarious influences include observations of masters, observations of entire acts or specific act components, comparison with peers attempting to achieve the same goals, and even self-modeling, for example videos of one's entire successful past performances or important parts of them. Vicarious influences are best when the role model i) fails, ii) struggles, and iii) overcomes failure.
Verbal persuasion	Self-efficacy is strengthened through verbal persuasion, evaluative feedback, self-talk, and expectations of others.
Physiological information	The general rule is that, when the individual perceives positive physiological states as resulting from study or training, self-efficacy improves; conversely, when negative physiological states such as anxiety, headaches or discomfort are associated with study or training, self-efficacy decreases.
Emotional states	The general rule is that, when the individual perceives positive emotional states as resulting from study or training, self-efficacy improves; conversely, when negative emotional states such as anxiety or discomfort are associated with study or training, self-efficacy decreases.
Imaginal experiences	Self-efficacy is improved through imagining oneself succeeding, practicing, or even imagining oneself confident.

Feltz et al., 2008; Lenz & Shortridge-Baggett, 2002.

A person trained in the taxonomies is able to evaluate and differentiate between competing syllabi. For example, using the taxonomy of Anderson and Krathwohl (2001), if one syllabus emphasizes remembering, understanding and applying while a second syllabus emphasizes analyzing, evaluating and creating, then the second syllabus is superior. It is superior in the sense that students using the second syllabus will be better able to engage in higher cognitive thinking. The judgment of superiority is based on the fact that remembering, understanding and applying are at lower levels of the taxonomy while analyzing, evaluating and creating are at higher levels of the taxonomy.

Current Pedagogic Practice

Simultaneously with the development of pedagogic theory, there was a development of pedagogic practice. Pedagogic practice underwent a transformation from the traditional active-instructor and passive-student model to numerous alternative models in which the student takes a more active role. The pedagogic delivery methods that were developed were successful, brought greater satisfaction to students, and increased retention and analytic capacity, for example:

- Flipped classroom (Bergmann & Sams, 2012; Strayer, 2012),
- Team-based learning (TBL) (Hills, 2001),
- Project-based learning (PBL) (Patton, 2012), and
- Inquiry-based learning (IBL) (Wallace & Husid, 2011).

Besides pedagogic theory and pedagogic practice, pedagogic evaluation also underwent a transformation. Assessment for learning (AFL) (Black et al., 2003,2004; Black & Wiliam, 1998), advocated that students should not be evaluated by instructors with letter grades. Rather, the evaluation process should be replaced with a coaching process identifying weak and strong areas and urging students to improve. The evaluation process is supplemented by student teams in which students can be coached and evaluated by peers.

AFL produced classrooms of students who learn in teams that perform projects. The students participate in their own teaching and evaluation. The projects they perform are typically open-ended questions which they have to research to solve. The results are students who are better equipped to exercise higher cognitive function.

Contribution of This Chapter

This chapter advocates that it is sufficient, for purposes of identifying good pedagogy, to use four education drivers which reflect deep underlying attributes of good pedagogy (Hendel, 2015b). It enables penetrating beneath the surface of modern pedagogy, beneath the taxonomies, practices and evaluation, and identifying core attributes of educational excellence. The Application section of this chapter analyzes approximately one dozen pedagogical innovations and shows how knowledge of the four drivers suffices to identify their pedagogic excellence.

For purposes of this Background section, we provide one illustrative example contrasting use of the four educational drivers vs. the educational hierarchies.

- Creativity, the highest level in the taxonomy of Anderson and Krathwohl (2001) is not S.M.A.R.T.; creativity is general and not specific; creativity cannot be mastered in a short time; creativity is not measurable. Hence, this taxonomy does not fulfill the educational driver of goal-setting.
- Contrastively, Van Hiele's (1986) approach to Geometry does fulfill the criteria of proper goal-setting. In fact, a chief virtue of the Van Hiele (1986) approach is that it correctly identifies the stages that any student most traverse to successfully master Geometry.

Each Geometry student, according to Van Hiele, must go through the following five stages*:*

- Visual,
- Analysis,
- Abstract,
- Deduction, and
- Rigor.

Additionally, Van Hiele (1986) provided goal-setting within each stage:

- Information,
- Guided orientation,
- Explication,
- Free orientation, and
- Integration.

Thus, the four educational drivers presented in this chapter do suffice, by themselves, to identify good pedagogy without using the educational hierarchies.

Leadership

The four educational drivers presented in this chapter are easily mastered by all educational stakeholders, mentors, principals, tutors, instructors and students. By focusing on leadership activities, the methods of assessing good instructional approaches, vs. leadership people, the people who assess good instructional approaches, the chapter facilitates the creation of a culture of shared co-leadership.

Throughout the Application section, examples are presented where an idea is noted, evaluated by the four drivers, developed, shared and refined. The initiation of the process does not require funding or hierarchical leadership; rather, it requires confidence in the outcome, improving student learning, retention, satisfaction and understanding. This confidence is vested in the initiator by the four educational drivers. Thus, the key point to emphasize is that these tools, the four educational drivers, are easily mastered by students, tutors, teachers, principals and mentors and hence, because all stakeholders can perform the leadership activities of selecting best instructional practices, a culture of cooperation and team work is naturally created.

APPLICATIONS

The introductory sections of this chapter presented four educational drivers characteristic of higher cognitive pedagogy. These drivers are easily masterable, facilitating fully shared co-leadership. This Application section explores approximately a dozen specific educational innovations. For each innovation, the chapter presents:

- A statement of the subject area.
- A brief description of the specific pedagogy used (full details may be found in the references).
- An indication of which of the four education drivers of this chapter the application excels in.
- A discussion of how fully shared co-leadership could facilitate development of the idea.

The Tree-Diagram Method for Writing

The tree-diagram method (Nair et al., 2012) is a visual-graphical method designed to improve writing. The basic idea is as follows:

- A writing theme is given.
- The student circles the writing theme on a piece of paper.
- The student then decides on a few ideas to develop this theme.
- Each idea is written down, circled, and connected by a line to the theme idea.
- Each of the development ideas is then, if warranted, further developed with other ideas.
- These ideas are also written down, circled and connected to the theme development idea they develop.
- The themes and developments are typically expressed in one to three word phrases.
- The entire piece of paper with circled ideas has a tree-like structure with the theme as the root.
- The paper with the tree-like structure is then used as a basis to writing a full essay.

The tree-diagram method excels at two of the four educational drivers presented in this chapter:

- **Executive Function:** The tree-diagram emphasizes executive function since it approaches writing using two brain areas, writing and visual.
- **Self-Efficacy:** The authors (Nair et al., 2012) emphasize that using the tree-diagram method gives students a sense of mastery and control and increases their self-efficacy.

The tree-diagram method fully illustrates the type of shared co-leadership advocated in this chapter.

- The statement of the tree-diagram idea, without further development, was found in a book on essay writing (Smalley, Ruetten, & Kozyrev, 2000).
- Lee (2004) found the idea interesting and tried it in the classroom. As a basis for his decision to explore the method, Lee (2004) emphasized use of two areas of the brain, the visual and verbal.

- Nair et al. (2012) built on what Lee (2004) had published and did the following: further developed it, collaborated with High Schools, and rigorously tested it using statistical methods. Besides emphasizing the visual aspects of the method, Nair et al. (2012) emphasized the improvement in mastery (self-efficacy).
- Nair et al. (2012) indicated that the results were still "experimental," indicating that other instructors or institutions may wish to further pursue the method.

Thus, the tree-diagram method is a paradigm of the type of fully shared co-leadership advocated in this chapter. The important point is to empower instructors with the means of recognizing good teaching techniques and to encourage them to pursue them further.

Calculus

Roughly three decades ago, Hughes–Hallett initiated an approach to calculus by emphasizing *the rule of four,* that each calculus problem, class example, homework, projects, etc., be approached using four distinct areas of the brain:

1. Verbal (verbal problems),
2. Visual (graphs),
3. Formal, and
4. Computational (Hendel, 2015a; Hughes-Hallett et al., 2013).

Consequently, this approach to calculus excels in executive function, the pedagogic driver emphasizing utilizing multiple brain areas.

The actual implementation of this project currently involves coordination with several dozen four-year and two-year colleges using a hierarchical shared leadership model. The project resulted in several collaborations and books and the Harvard Consortium Calculus (Knill, 2009). Nevertheless, the project began with one instructor noticing that consistently using all four brain areas in problems led to a superior student experience and performance in calculus. Once this was noticed, the idea could be further shared, developed and funded in a more organized manner. This development is consistent with the concept of fully shared co-leadership presented in this chapter.

Essay Writing

The Jones and Faulkner (1977) approach to essay writing excels in goal-setting. A contrast will clarify this.

- A typical response to a weak essay writer might be, "Try harder," or, "You possibly do not have the innate writing ability needed for good writing." Such responses violate principles of goal-setting ("Try harder" without a further breakdown of skills) and attribution theory (attribution to lack of innate ability).
- Contrastively, the Jones and Faulkner (1977) response to a weak essay writer would be an emphasis on goal-setting, sequences of learnable component skills which when all mastered would enable good essay writing.

The goal-setting of Jones and Faulkner (1977) is accomplished by enumerating four main methods to link sentence pairs and five main methods to develop paragraphs. They also present several templates for combining paragraphs into essays. For illustrative purposes, one or two examples are given. The four sentence-pair methods are:

- Enumerative meaning,
- Equal meaning,
- Subsidiary meaning, and
- Dominant meaning.

The skills of creating *equal meaning* sentence pairs is further broken down into the component skills of:

- Definition,
- Amplification,
- Sample item,
- Supporting data,
- Cause and analogy.

Each of these component skills is strengthened by specific illustrations and exercises. The mastering of paragraph types and essay types is similarly accomplished through specific exercises. The important point here, is that a response to a weaker essay writer is always an emphasis on acquiring specific skills by doing specific measurable tasks that can be mastered in a short time.

Although, the Jones and Faulkner (1977) method primarily excels in goal-setting, it secondarily excels in other pedagogic drivers. Goal-setting facilitates attributing success internally (telling the student that they must internalize and master certain skills), and internal attribution in turn leads to a heightened sense of confidence and self-efficacy.

In terms of leadership, Jones and Faulkner (1977) developed these ideas after teaching for many years. Based on their experience, they created a clear set of goal-setting paradigms accompanied by exercises. Their leadership expressed itself by writing a book and getting feedback from other instructors. There was no official project, no official project director and no specific funding. The idea was initiated from observations and applications of basic principles of good pedagogy. Once started, the idea developed through the shared experiences of participants. The Jones and Faulkner (1977) approach was not a big project; for example, it was not shared with other universities the same way the Harvard Consortium Calculus (Knill, 2009) was. However, it was a project. In the preface to the book, Jones and Faulkner (1977) express gratitude for the suggestions and encouragement of other instructors who used earlier editions of their book. Thus, this writing approach illustrates the type of fully co-shared leadership discussed in this chapter.

Polya's Problem Solving Method

The importance of goal-setting can be appreciated by applying the principles of goal-setting to Polya's (1957) popular, four-step, mathematical, problem-solving method. Polya (1957) asserted that to solve a problem, one should go through four steps or stages:

1. Understand the problem.
2. Devise a plan.
3. Implement the plan.
4. Look back.

However, this four-stage process does not meet the S.M.A.R.T. criteria of goal-setting. The steps are not specific; on the contrary, the steps are open ended. These steps are also not achievable in a short time period (indeed, for example, one might spend a long time trying to find a successful plan).

Why, then, is Polya (1957) so popular? Upon reading his book, one finds that each of the steps is finely subdivided into further steps. These further steps are often specific, realistic, challenging, and achievable in a short time, that is, they are S.M.A.R.T. and fulfill the criteria of successful goal-setting. Hendel (2014a) illustrates how to apply proper goal-setting to algebraic verbal problems consistent with the four-step plan of Polya (1957). A brief summary is as follows:

1. **Understand the Problem:** Polya (1957) explains this as identifying what is unknown. Hendel (2014a) implements this as follows:
   a. Identify the unknowns; circle the associated words and label them *x, y, z, ….*
   b. Identify key words for mathematical verbal problems such as *same, equal, more, less, times.*
2. **Devise a Plan:** Polya (1957) explains this as identifying the techniques to be used. Hendel (2014a) implements this very specifically in short-term achievable goals as follows:
   a. Use an algebraic-verbal dictionary to translate the keywords into algebra.
   b. For example, *equal, same* corresponds to "="; *more* corresponds to "+"; *less* corresponds to "-"; *times* corresponds to "x" etc. This verbal-algebraic dictionary implements executive function.
3. **Implement the Plan:** Hendel (2014a) explains the implementation as follows:
   a. Using the explicit identification of variables in 1(a) and the algebraic functions identified in 1(b) and 2(b), the entire verbal problem is reformulated algebraically.
   b. The resulting set of algebraic equations can now be solved by mechanical processes.
4. **Look Back:**
   a. Polya (1957) simply asks us to check that the numerical solution is reasonable (for example, if the solution to a quadratic equation is negative this may be inconsistent with the verbal meaning of the unknown involved).

To summarize, the method of Polya (1957) is successful because the sub-steps of his main four-step program for solving problems fulfill the criteria of S.M.A.R.T. and challenging goal-setting.

The remainder of this Application section lists some popular, pedagogically effective, teaching methods. In each case, it is shown that the method is successful *because* of the strong presence of one of the four educational drivers presented in this chapter.

Inquiry-Based Learning (IBL)

The main feature of IBL is an emphasis on teaching through the vehicle of questions (inquiries) rather than through a vehicle of statements of fact and theory (Wallace & Husid, 2011).The success of IBL is due to its open-ended questions. Although this chapter has emphasized performance executive function,

open-ended questions are also a major type of executive function since their solution requires synthesis of a solution from multiple brain areas (Toplack et al., 2013).

IBL works better when combined with scaffolding (Wallace & Husid, 2011) which roughly corresponds to what this chapter calls goal-setting, the breaking down of a complex task into small chunks each of which is masterable in a short period of time.

Problem-Based Learning (PBL)

The main feature of PBL is an emphasis on defining educational objectives through projects (Patton, 2012). The projects are typically implemented through class teams. The success of PBL is due to goal-setting and executive function. All projects begin with goal-setting, the componential analysis of the project goal into a sequence of project steps. Care must be taken that individual project steps are:

1. Specific,
2. Challenging,
3. Realistic, and
4. Achievable in the short term (Locke & Latham, 1990; Locke et al., 1981).

The integration of these project steps into a whole requires executive function.

Flipped Classroom

The main feature of flipped classroom consists of flipping the roles of teacher and student (Bergmann & Sams, 2012; Strayer, 2012). There are many variations of flipped classroom but typically, the students will learn the material at home vs. in class. This can be facilitated by videos of lectures. The classroom is then devoted to instructional activities, laboratory activity and solving homework-type problems which are challenging. Thus, the classroom is flipped since the students do the learning at home while the teacher assists in homework in class.

The success of flipped classroom is due to executive function and attribution theory. Bringing the homework into the classroom, flipping the classroom, encourages more challenging problems, problems with several component problems, or problems with open-ended questions, that is, problems with executive-function quality. Similarly, giving students the responsibility of learning the material at home creates internal attribution (the student must learn by himself or herself) vs. external attribution (learning from the instructor).

Team-Based Learning (TBL)

The main feature of TBL is an emphasis on students learning in teams (Hills, 2001). TBL, of course, can be combined with other instruction methods. The success of TBL is based on self-efficacy. Working in a properly constructed team provides the vicarious support of role models, people who have struggled with a problem and have succeeded. Working in a team also provides verbal persuasion since team members are supporting each other (Black et al., 2003, 2004). Table 5 lists both persuasion and vicarious support as important drivers of self-efficacy. There is also a rich and separate literature on team self-efficacy (Feltz et al., 2008, pp. 119-149).

Assessment for Learning (AFL)

Assessment for Learning has multiple educational characteristics including:

1. Skillful use of open-ended questions during lecture.
2. An emphasis on assessment by comments vs. letter grades with an emphasis on constructive evaluation, explaining to students what they need to improve.
3. Skillful use of peer assessment and teams (Black et al., 2003, 2004).
4. An emphasis on specific learning objectives (SLO) (Black & Wiliam, 1998).

Corresponding to each of the above items are the following educational drivers:

1. Open-ended questions require executive function for their response (Toplack et al., 2013).
2. Assessment by comments leads to successful attribution since the comments enable students to control further learning; furthermore, while a grade is external (from the instructor), the comments are directed to internal processing of the student.
3. The use of teams and peers facilitates proper role models, vicarious influence, and proper verbal persuasion which are key drivers of self-efficacy.
4. The emphasis in SLO is on the breakdown of educational objectives into small specific steps achievable in a short time (S.M.A.R.T.). Hence, SLO fulfills good goal-setting.

More could be said about AFL, but for purposes of this chapter, the above, showing how the four educational drivers drive the success of AFL, is sufficient.

The leadership style for developing AFL illustrates both fully shared co-leadership and hierarchical shared leadership. Initially, AFL started with two instructors reviewing several dozen papers on SLO and noticing its efficacy (Black & Wiliam, 1998). This was followed by following the principles, sharing with other instructors and more publications, consistent with the model of fully shared co-leadership advocated in this chapter. However, the implementation of AFL (Black et al., 2003; Black et al., 2004) on a larger scale in several schools in the United Kingdom required shared hierarchical leadership since coordination of principals, instructors and students as well as compliance with United Kingdom educational requirements was necessary. Additionally, the intensity of the implementation required training of instructors. Such evolving from an initiation using fully shared co-leadership followed by a larger scale development using hierarchical shared leadership is also seen in the Harvard Consortium Calculus (Knill, 2009) presented above.

IMPLICATIONS FOR FUTURE POLICY AND RESEARCH

Throughout this chapter, many implications for research and teaching have already been presented. These implications are summarized below.

- **Higher Cognitive Pedagogy:** This chapter advocates teaching higher cognitive pedagogy by training instructors in use of the four educational drivers. This chapter further advocates that the

four educational drivers should have a primary emphasis while the traditional pedagogical hierarchies should have a secondary emphasis.

- **Educational Stakeholders:** The four educational drivers and the methods of this chapter should be taught and shared with all educational stakeholders:
  - Mentors,
  - Principals,
  - Instructors,
  - Tutors and
  - Students.
- **Leadership Styles:** This chapter advocates a fully shared co-leadership style. Any educational stakeholder, particularly instructors as well as principals, can initiate educational reform. Upon seeing some success, the initiator can share the idea and further test it in a shared environment. Crucial to fully shared co-leadership is the idea that good pedagogy is assessed using the four educational drivers. However, the full development of an idea may require a shared hierarchical leadership style.
- **Research:** This chapter advocates that any instructor can initiate a fruitful educational innovation. Crucial to this sharing of leadership is the importance of encouraging instructors to publish small classroom successes they have achieved.
- **Educational Level:** Many of the examples of shared co-leadership in this chapter were initiated at the university level followed by more intense development with K-12 or two-year colleges. The Harvard Consortium Calculus (Hughes-Hallett et al., 2013; Knill, 2009), the tree diagram method (Nair et al., 2012), and AFL (Black et al., 2003; Black et al., 2004; Black & Wiliam, 1998) illustrate such partnerships. Other examples of university partnerships with high-schools are the Science and Mathematics Academy at Flinders, Australia (SMAF)(Clark, 2014) or the coordination of Harvard university research with AMIT (Chabin, 2015). Consequently, this chapter advocates such university-initiated, high-school developed partnerships.
- **Skill Acquisition:** This chapter advocates the use of proper goal-setting to ensure that any subject can be learned by mastering a collection of specific skills. The Jones and Faulkner (1977) approach to writing neatly illustrates innovation in skill acquisition, since, traditionally, essay writing is considered a field where you either have an innate ability or not.
- **Teams:** This chapter has expanded the meaning of team. In an electronic age, a team can be formed electronically even though the members never see each other or get together in a single setting. The Hughes-Hallett approach to calculus (Hughes-Hallett et al., 2013) and the tree diagram method (Nair et al., 2012) illustrate this.

CONCLUSION

This paper has defined, explored, and illustrated four primary drivers of educational excellence:

- Executive function,
- Attribution theory,
- Goal-setting, and
- Self-efficacy.

These drivers apply to a variety of disciplines, including mathematics and writing, expose an underlying unity of many current educational innovations, IBL, PBL, AFL, TBL and flipped classroom, and facilitate curriculum design, skill acquisition, and problem solving. These four educational drivers dynamically empower the next-generation educational instructor to assume leadership roles, transforming lower cognitive instruction to higher cognitive instruction as well as enabling universal accessibility to skill acquisition. Most importantly, these four drivers dynamically facilitate fully shared co-leadership in which any instructor can initiate innovation in pedagogic delivery.

REFERENCES

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*. New York, NY: Longman.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. doi:10.1037/0033-295X.84.2.191 PMID:847061

Bandura, A. (1997). *Self-efficacy. The exercise of control*. New York, NY: Freeman.

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science*, *9*(3), 75–78. doi:10.1111/1467-8721.00064

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, *52*(1), 1–26. doi:10.1146/annurev.psych.52.1.1 PMID:11148297

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Arlington, VA: International Society for Technology in Education.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: Putting it into practice*. Maidenhead, UK: Open University Press.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan*, *86*(1), 8–21. doi:10.1177/003172170408600105

Black, P., & Wiliam, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, *80*(2), 139–148.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals*. New York, NY: Longmans, Green and Company.

Bowie, C. R., & Harvey, P. D. (2006). Administration and interpretation of the Trail Making test. *Nature Protocols*, *1*(5), 2277–2281. doi:10.1038/nprot.2006.390 PMID:17406468

Butler, R. (1988). Enhancing and undermining intrinsic motivation: The effects of task- involving and ego-involving evaluation on interest and performance. *The British Journal of Educational Psychology*, *58*(1), 1–14. doi:10.1111/j.2044-8279.1988.tb00874.x

Chabin, M. (2015). GOGYA: The revolutionary pedagogical program established by AMIT. *AMIT Magazine*, *87*(4), 8–13.

Clark, J. V. (Ed.). (2014). *Closing the achievement gap from an international perspective: Transforming STEM for effective education*. New York, NY: Springer. doi:10.1007/978-94-007-4357-1

Cobb, P. (2008). *The challenges of scale: Designing learning organizations for instructional improvement in mathematics*. Paper presented at the International Congress on Mathematical Education (ICME)11, Monterrey, Mexico.

Cordeiro, P. A., & Cunningham, W. G. (2013). *Educational leadership: A bridge to improved practice* (5th ed.). Boston, MA: Pearson Education.

Corrigan, J. D., & Hinkeldey, N. S. (1987). Relationships between parts A and B of the Trail Making test. *Journal of Clinical Psychology*, *43*(4), 402–409. doi:10.1002/1097-4679(198707)43:4<402::AID-JCLP2270430411>3.0.CO;2-E PMID:3611374

Duignan, P. A. (2006). *Educational leadership: Key challenges and ethical tensions*. Cambridge, UK: Cambridge University Press.

Dweck, C. S. (1986). Motivational processes affecting learning. *The American Psychologist*, *41*(10), 1040–1048. doi:10.1037/0003-066X.41.10.1040

Feltz, D. L., Short, S. E., & Sullivan, P. J. (2008). *Self-efficacy in sport*. Champaign, IL: Human Kinetics.

Gagne, R. M. (1985). *The conditions of learning and theory of instruction* (4th ed.). New York, NY: Holt, Rinehart and Winston.

Gaudino, E. A., Geisler, M. W., & Squires, N. K. (1995). Construct validity in the Trail Making Test: What makes Part B harder? *Journal of Clinical and Experimental Neuropsychology*, *17*(4), 529–535. doi:10.1080/01688639508405143 PMID:7593473

Harris, A. (2008). *Distributed school leadership: Developing tomorrow's leaders*. London: Routledge.

Hendel, R. J. (2014a). A discipline-independent approach to a higher order cognitive pedagogy. *Journal of Systemics*, *Cybernetics and Informatics*, *12*(5), 16–21.

Hendel, R. J. (2014b). *Closing the achievement gap from an international perspective*. Retrieved from http://www.maa.org/press/maa-reviews/closing-the-achievement-gap-from-an-international-perspective

Hendel, R. J. (2015a). The rule of four, executive function and neural exercises. *Journal of Systemics*. *Cybernetics and Informatics*, *13*(5), 14–19.

Hendel, R. J. (2015b). Towards a new cybernetic interdisciplinary approach to pedagogic challenge. *Journal of Systemics*. *Cybernetics and Informatics*, *13*(6), 99–104.

Hills, H. (2001). *Team-based learning*. Aldershot, UK: Gower.

Hopkins, D., & Harris, A. (2000). *Creating the conditions for teaching and learning: A handbook of staff development activities*. London: David Fulton Publishers.

Hopkins, D., Harris, A., & Jackson, D. (1997). Understanding the schools capacity for development: Growth states and strategies. *School Leadership & Management*, *17*(3), 401–412. doi:10.1080/13632439769944

Hughes-Hallett, D., McCallum, W. G., Gleason, A. M., Connally, E., Lovelock, D., Patterson, C., & Tucker, T. W. (2013). *Calculus: single and multivariable* (6th ed.). Hoboken, NJ: Wiley.

Jones, A. E., & Faulkner, C. W. (1977). *Writing good prose: A simple structural approach* (4th ed.). New York, NY: Scribner.

Kendall, J. S. (2011). *Understanding common core state standards*. Alexandria, VA: ASCD Publications.

Kitsantas, A., & Zimmerman, B. J. (1998). Self-regulation of motoric learning: A strategic cycle view. *Journal of Applied Sport Psychology*, *10*(2), 220–239. doi:10.1080/10413209808406390

Kitsantas, A., & Zimmerman, B. J. (2002). Comparing self-regulatory processes among novice, non-expert, and expert volleyball players: A microanalytic study. *Journal of Applied Sport Psychology*, *14*(2), 91–105. doi:10.1080/10413200252907761

Knill, O. (2009). *On the Harvard consortium calculus*. Retrieved August 23, 2016, from http://www.math.harvard.edu/~knill/pedagogy/harvardcalculus

Lee, C. (2004). Seeing is understanding: Improving coherence in students' writing. *The Internet TESL Journal, 10*(7). Retrieved from http://iteslj.org/Techniques/Lee-Writing

Leithwood, K. A., Jantzi, D., & Steinbach, R. (2009). *Changing leadership for changing times* (2nd ed.). Maidenhead, UK: Open University Press.

Lenz, E. R., & Shortridge-Baggett, L. M. (2002). *Self-efficacy in nursing: Research and measurement perspectives*. New York, NY: Springer Publishing Company.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal-setting and task performance*. Englewood Cliffs, NJ: Prentice Hall.

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal-setting and task performance: 19691980. *Psychological Bulletin*, *90*(1), 125–152. doi:10.1037/0033-2909.90.1.125

Maddux, J. E. (1995). Self-efficacy theory: An introduction. In J. E. Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory, research, and application* (pp. 3–33). New York, NY: Plenum Press. doi:10.1007/978-1-4419-6868-5_1

Marzano, R. J. (2001). *Designing a new taxonomy of educational objectives*. Thousand Oaks, CA: Corwin Press.

Nair, G. K. S., Rahim, R. A., Setia, R., Adam, A. F. B. M., Husin, N., Sabapathy, E., & Seman, N. A. (2012). Writing descriptive essays using 'the tree diagram' as a tool. *Asian Social Science*, *8*(7). doi:10.5539/ass.v8n7p40

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Orbach, I., Singer, R., & Price, S. (1999). An attribution training program and achievement in sport. *The Sport Psychologist*, *13*(1), 69–82. doi:10.1123/tsp.13.1.69

Parsley, D. (2009). School improvement's special ingredients. *Changing Schools*, *60*, 4–5.

Patton, A. (2012). *Work that matters: The teacher's guide to project-based learning*. London: Paul Hamlyn Foundation.

Pickens, S., Ostwald, S. K., Murphy-Pace, K., & Bergstrom, N. (2010). Systematic review of current executive function measures in adults with and without cognitive impairments. *International Journal of Evidence-Based Healthcare*, *8*(3), 110–125. doi:10.1111/j.1744-1609.2010.00170.x PMID:21199379

Polya, G. (1957). *How to solve it: A new aspect of mathematical method*. Garden City, NY: Doubleday Publishers.

Reitan, R. M. (1958). Validity of the Trail Making test as an indicator of organic brain damage. *Perceptual and Motor Skills*, *8*(3), 271–276. doi:10.2466/pms.1958.8.3.271

Schunk, D. H. (1995). Self-efficacy, motivation and performance. *Journal of Applied Sport Psychology*, *7*(2), 112–137. doi:10.1080/10413209508406961

Smalley, R. L., Ruetten, M. K., & Kozyrev, J. R. (2000). *Refining composition skills: Rhetoric and grammar* (5th ed.). Boston, MA: Heinle and Heinle.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research*, *15*(2), 171–193. doi:10.1007/s10984-012-9108-4

Toplack, M. E., West, R. F., & Stanovich, K. E. (2013). Practitioner Review: Do performance- based measures and ratings of executive function assess the same construct? *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *54*(2), 131–143. doi:10.1111/jcpp.12001 PMID:23057693

Van Hiele, P. M. (1986). *Structure and insight: A theory of mathematics education*. Orlando, FL: Academic Press.

Wallace, V. L., & Husid, W. N. (2011). *Collaborating for inquiry-based learning: School librarians and teachers partner for student achievement*. Santa Barbara, CA: Libraries Unlimited.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, *92*(4), 548–573. doi:10.1037/0033-295X.92.4.548 PMID:3903815

Zimmerman, B. J., & Kitsantas, A. (1996). Self-regulated learning of a motoric skill: The role of goal-setting and self-monitoring. *Journal of Applied Sport Psychology*, *8*(1), 60–75. doi:10.1080/10413209608406308

Zimmerman, B. J., & Kitsantas, A. (1997). Developmental phases in self-regulation: Shifting from process goals to outcome goals. *Journal of Educational Psychology*, *89*(1), 29–36. doi:10.1037/0022-0663.89.1.29

KEY TERMS AND DEFINITIONS

Attribution Theory: The analysis of how a person attributes success and failure using the three dimensions of i) locus (internal or external causes), ii) controllability and iii) stability. Attribution theory predicts that an internal, unstable, controllable attribution for success, for example, attribution based on effort, is an important predictor of future success.

Driver: A deep or root cause. A driver corresponds to a driving force.

Educational Hierarchy: A typical educational hierarchy describes various possible levels of cognitive challenge. The attributes of each level are clearly defined, enabling a person who has mastered the hierarchy to correctly classify and differentiate different educational delivery methods using the hierarchy.

Executive Function: The brain function which facilitates a person doing a task by simultaneously doing several tasks, each associated with a possibly different brain area.

Goal-Setting: An attribute of the stepwise analysis of a complex task into component tasks. Goal-setting theory predicts that learning, retention and student satisfaction are increased when steps of a complex task are i) specific, ii) challenging, iii) realistic, iv) achievable, v) attainable in a short amount of time, vi) clear, vii) measurable, and viii) accompanied by feedback. Goal-setting is also called measurability.

Rule of Four: A pedagogic technique for teaching calculus, in which each course concept is approached in four distinct ways: i) verbally, ii) graphically, iii) computationally and iv) formally.

Self-Efficacy: A person's belief that by using and integrating his/her current skills he/she can accomplish a specific task. Self-efficacy is the most important agentic factor predicting success. The most important driver of self-efficacy is past performance successes. Role models (vicarious influence) and verbal persuasion also contribute significantly to self-efficacy.

Tree-Diagram Method: A pedagogic technique to enhance writing ability that advocates using a tree-like outline to guide the person in essay writing. Mastery of the tree-diagram technique increases self-efficacy, an important predictor of future success.