Real Engagement in Active Problem Solving (REAPS): An evidence-based model that meets content, process, product, and learning environment principles recommended for gifted students

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Abstract

In this article, we begin with a short discussion of teaching and learning models, then describe what we believe is an exciting new model that can be used effectively in the teaching of gifted students. The main focus of this article is on the evidence showing that it is comprehensive (i.e., it is a way to implement all the curriculum principles important in teaching gifted students), flexible (i.e., can be used with a variety of ages of students, in a variety of settings, in many cultural contexts, and in many types of programmes) and valid (i.e., it has a research base showing that it has been developed using appropriate methods and is effective with all students, especially those who are gifted).

The importance and selection of teaching and learning models

A teaching-learning model is a structural framework that serves as a guide for educators to develop specific learning experiences and environments. The factors common to teaching models are (a) a purpose or focus, (b) assumptions about learners and the teaching-learning process, (c) guidelines for designing day-to-day learning experiences, (d) patterns and requirements for these experiences, and (e) a body of research surrounding their development or evaluation of their effectiveness. Authors recommend the use of teaching-learning models because they provide an integrated and consistent system for designing instruction and assessment (c.f., Maker & Schiever, 2005; Maker & Schiever, 2010; Renzulli & Reis, 2008).

The use of appropriate teaching-learning models is an important way for educators to implement the curriculum principles recommended for gifted students. However, the models chosen must be appropriate to the context in which they will be used, flexible or adaptable, practical, and valid. They also must be comprehensive enough to either incorporate all of the content, process, product, and learning environment principles or be compatible with other models that, when combined, can incorporate all the principles important for teaching gifted students (Maker & Schiever, 2005).

For many years, Maker experimented with numerous combinations of teaching-learning models and worked with teachers and curriculum specialists to implement them in programmes for the gifted. Based on an extensive review of research and literature completed for the first phase of the Developing Curricula for Creativity and Innovation in Saudi Arabian Special Schools for Gifted

Students (Maker, Alhusaini, Zimmerman, Pease, Schiever, & Whitford, 2014) and our experience in programmes for the gifted, we recommend the use of the Real Engagement in Active Problem Solving Model (REAPS) as an evidence-based teaching-learning model that can be effective in a variety of settings, cultures, and types of programmes designed to serve gifted and talented learners.

**REAPS Model**

Research and development of the REAPS model began in 2004 when Maker, Zimmerman, and Schiever, in collaboration with doctoral students from Turkey, Saudi Arabia, Taiwan, Russia, and Egypt used the three models together in a professional development project for teachers of the gifted in math and science from Korea (Maker & Zimmerman, 2008). Teachers from Korea implemented it in Seoul. In cooperation with a public school, the Navajo Indian Nation, we worked with elementary and middle school teachers to implement it in several classrooms (Reinoso, 2011). We and the teachers believed it was successful in those two very different contexts, so we applied it, with Randal Pease as the teacher and doctoral students from Turkey, Saudi Arabia, and Chile as collaborators, in elementary classrooms of students with varied levels of abilities over a period of 5 years. We found that it was practical and successful in increasing students’ content knowledge and in facilitating the teachers’ implementation of a science curriculum and state standards (Zimmerman el al., 2011).

Student interviews demonstrated that they believed the model was an important aspect of their learning of science, and that it was challenging and engaging (Gomez-Arizaga, Bahar, Maker, Zimmerman, & Pease, 2014). In Saudi Arabia, researchers worked closely with three 3rd grade teachers in classrooms in a public elementary school located in an urban area in the western region of Saudi Arabia (Alhusaini, Maker, & Alamiri, in preparation). We found that the creativity scores of the students in the experimental group were significantly higher than the scores of students in the comparison group. All teachers, in structured interviews, agreed that the model could be implemented most effectively in classes with 25 or fewer students. All teachers also agreed that the REAPS model was beneficial in improving students’ skills. They made several suggestions for improving the model, which we have incorporated into our work.

At this time, we are implementing the model in a large elementary school in Sydney, Australia. We began with a group of experimental teachers, and because of the success of the approach, the administrators and teachers at the school decided to implement it school-wide. We have administered pre- and post-tests of general creativity, scientific creativity, mathematical problem solving, and concept maps to assess content understanding. We also have interviewed students and observed teachers. We will interview teachers, administrators, and parents as part of the project. The data from the assessments and student interviews are currently being analyzed, and we plan to present the findings to the faculty and administrators of the school in February 2015. At that time, we also will complete the interviews.
Our most significant implementation of the REAPS model is being planned in cooperation with the Ministry of Education and King Abdulaziz University in Saudi Arabia. In 2014, we completed an extensive review of the literature and research on curriculum principles and models for teaching gifted students (Maker, Alhusaini, Zimmerman, Pease, Schiever, & Whitford, 2014) and recommended a curriculum framework consisting of Macro Concepts (big ideas and cross-disciplinary concepts), Benchmarks in Literacy and Numeracy (across all academic disciplines) and Personal and Social Capability (across all academic disciplines), and Discipline-Based Concepts. We also recommended the use of the REAPS model because of its research base and comprehensiveness (Maker, Alhusaini, Zimmerman, & Pease, 2014). We are working closely with the Ministry of Education and King Abdulaziz University to implement this framework, the principles supported by research, and the REAPS model in special schools for gifted students, grades 1-12, that will be built in major areas in Saudi Arabia. If the pilot project (3 schools) is successful, schools will be built in all regions of Saudi Arabia based on the results of the pilot project.

The three models that make up REAPS complement each other because they all develop problem solving in different ways, which is the main emphasis of the REAPS model. Discovering Intellectual Strengths and Capabilities while Observing Varied Ethnic Responses (DISCOVER) provides a wide array of problem types that can be used to guide students’ thinking and development of content understanding throughout a unit or lesson. Thinking Actively in a Social Context (TASC) provides the structure, sequence, and organization for creating solutions to problems in both group and individual settings, especially those that are open-ended. Finally, Problem Based Learning (PBL) offers a way of integrating content in practical and real-life applications.

**Problem Based Learning (PBL)**

When teachers use PBL, they choose problems from their local, regional, or national context, and as students become more sophisticated, from international contexts. However, these problems should be real, not contrived, and because they are real, they are complex, with multiple factors to consider and multiple methods that are appropriate for solving them. Students often are placed in stakeholder groups or other groups in which they must consider a problem from multiple perspectives. They develop realistic solutions and present these solutions to real audiences. Often, panels of individuals from the classroom, other classrooms, or the community listen to these presentations, ask questions, complete evaluations, and make recommendations.

**Thinking Actively in a Social Context (TASC)**

TASC is essentially a structured problem solving process. The problem solving process in TASC is depicted as a wheel, signifying that it is not linear and not restrictive. Although the parts of the wheel can be completed in a particular order, that order is not essential, nor is it always desirable. Much of the process of problem solving is recursive, one in which the problem solvers return to
an earlier stage to re-think a plan, gain new information, come up with new ideas, and re-evaluate their plans. The model consists of eight sections: Gather and Organize, Identify the Task, Generate, Decide, Implement, Evaluate, Communicate, and Learn from Experience.

**Discovering Intellectual Strengths and Capabilities while Observing Varied Ethnic Responses (DISCOVER)**

The DISCOVER model consists of two major components: (a) a problem continuum in which six types of problem solving situations are distinguished according to how much information is given to or specified for the problem solver and how much is not given or not specified; and (b) emphasis on Multiple abilities (Gardner, 1983) or multiple ability areas (Maker & Anuruthwong, 2003) in which all individuals have strengths. Other important components of the model include implementation of the following important methods (Kuo, Maker, & Su, 2011; Kuo, Maker, Su, & Hu, 2010; Maker, 2001; 2008; Maker, Muammar, & Jo, 2008; Maker, Muammar, Serino, Kuang, Mohamed, & Sak, 2006):

1. Provide opportunities for students to develop their multiple abilities;
2. Provide opportunities for students to solve a variety of types of problems;
3. Use active, hands-on learning with the “tools” of the multiple abilities;
4. Integrate the culture of the students and of the community into the curriculum; and
5. Plan curricula around state standards and abstract themes.

**Content principles: What to teach**

**Abstractness: Focusing content on teaching macro concepts or “big ideas”**

**PBL**
The principle of abstractness is included in PBL because the teacher chooses or writes, based on the interests of students, a problem that has a Macro Concept as the overall focus of the problem solving. The key question for the teaching unit involving this problem also is based on the Macro Concept(s).

**TASC**
This principle is not addressed in the TASC model, but it can easily be incorporated by combining it with DISCOVER and PBL.
DISCOVER
One of the basic principles in the DISCOVER model is that content is organized around broad-based interdisciplinary themes, called Macro Concepts in our framework.

Complexity: Including Macro Concepts and Complexity of Content

PBL
Real life problems, the basis of PBL, are by their very nature complex. The addition of stakeholders and an emphasis on multiple perspectives taken by different groups also adds complexity.

TASC
This principle is not addressed in the TASC model, but it can easily be incorporated by combining TASC with DISCOVER and PBL.

DISCOVER
Included in the principle of organization around broad-based interdisciplinary themes is the idea that these themes cut across the traditional academic areas, thus increasing complexity. Posing the open-ended problems on the DISCOVER continuum also increases complexity of content.

Variety

PBL
A variety of problems can be presented based on the areas of interest of the students. These problem solving experiences can be extensions of the curriculum either in depth, breadth, or pace (studying content usually taught at higher grade levels).

TASC
Variety in content is introduced in the TASC model when students generate new ideas, and can be a part of their implementation of these ideas.

DISCOVER
Integration of student interests, culture, and language into the curriculum is one of the basic principles of DISCOVER, and this integration facilitates variety in content. Because multiple abilities are emphasized, content from diverse areas is included in the curriculum.

Organisation for learning value: Organising Content around Macro Concepts

PBL
In PBL, both the problem scenario and the key question for the problem solving experience have
the Macro Concept as their basis. These Macro Concepts are used as a guide for selecting content within and across disciplines that are both related to the problem and related to the academic content students are expected to learn.

**TASC**
This principle is not addressed in the TASC model, but it can easily be incorporated by combining it with DISCOVER and PBL.

**DISCOVER**
One of the basic principles in the DISCOVER model is that content is organized around broad-based interdisciplinary themes, called Macro Concepts in our framework.

**Study of people: Studying the lives and contributions of gifted and productive people**

**PBL**
This principle is not specifically addressed as part of the PBL model, but can be easily incorporated through studying the contributions of the creative and productive people who have solved similar problems.

**TASC**
This principle is not addressed in the TASC model, but it can be incorporated easily by studying the characteristics of and methods used by creative and productive people.

**DISCOVER**
This principle is not addressed specifically in the DISCOVER model, but needs to be incorporated by studying the characteristics of creative and productive people from the students’ own cultures.

**Study of methods: Study of the methods appropriate in varied disciplines**

**PBL**
During the solving of a real problem in PBL, students collect data using the methods appropriate for the type of problem being solved and employ research or observational techniques appropriate to the discipline.

**TASC**
The TASC model could be considered to be a meta-method because when one follows the steps identified in the model, a problem or task is completed using creative and productive thinking in a systematic way. It is a method that can be used across disciplines and projects.
DISCOVER
When using the DISCOVER curriculum model teachers demonstrate a variety of processes (across intelligences and content areas) and they give students opportunities to use these processes. The problem continuum includes two types in which students learn to use specific methods and four types in which they select, create, and apply their own methods.

Process principles: The learning and teaching processes used

Higher levels of thinking: Emphasising use of information rather than remembering it

PBL
When solving a real problem in PBL, students must gather information using appropriate methods, apply this information, and develop new and different solutions.

TASC
All levels of thinking are included in the TASC model, from remembering and listing information up to applying, creating, and evaluating it. The final step is metacognitive.

DISCOVER
All levels of thinking are included when the DISCOVER problem continuum is used. The emphasis on higher levels is greater when students are solving Types III to VI.

Open-Endedness: Asking open-ended questions and designing open-ended problems

PBL
The problems chosen are provocative—they may be persistent or particularly challenging. Various stakeholders or those with divergent perspectives may propose different solutions, and none could be considered “correct”.

TASC
In the TASC model, open-endedness is part of each step, even those in which a decision is made. When they Gather and Organize, students list what they know, what they want to know, and where they might find this information. The Identify step may be the least open, as this is the time to focus on defining the task or problem. The next, Generating, may be the most open-ended because students generate as many ideas as possible to solve the problem. When they Decide, they do so on the basis of criteria they have developed. They Implement the solution they have devised, then Evaluate it based on the criteria they have developed. They Communicate
their solution using their own presentation skills or products, and finally, Reflect on what they learned from their experiences.

**DISCOVER**
The development of open-endedness across time, for both teachers and students, is an underlying concept in the DISCOVER problem continuum. The first two problems are closed, three and four are semi-open, and the last two are open. When solving a Type VI, the most open-ended problem, students identify, design, or describe their own problems and solve them in their own ways.

**Discovery: Facilitating students’ discovery rather than “teaching” them**

**PBL**
Discovery learning takes place during PBL when students draw on their own past experience, gather new information, discover new principles and relationships, and solve problems in unique ways. Students are active inquirers.

**TASC**
Discovery learning is incorporated into the TASC model in every step as learners are gathering, discovering, and creating new products and information.

**DISCOVER**
The problem continuum is the key aspect of DISCOVER when incorporating discovery. When students solve problem Type VI, they are using the highest form of discovery learning.

**Evidence of reasoning: Asking students to explain the reasons for their answers**

**PBL**
When students present their solutions to each other or to a real audience, they must justify their decisions by providing appropriate evidence.

**TASC**
At two of the steps in the TASC model, evidence of reasoning is explicit: Decide and Evaluate. Participants must decide on the best solution and evaluate the effectiveness of their implementation. Often, explaining reasoning also is part of the Communication step.

**DISCOVER**
This principle is not specifically addressed in the DISCOVER model, but should be incorporated. Teachers need to ask students to explain their reasoning when solving all types of problems.
Freedom of choice: Allowing students as much freedom to choose as possible

PBL
This principle is incorporated when teachers ask students to identify problems of concern or interest, and then create a scenario that is related to the problem of interest. It also is incorporated when students can choose a perspective or a stakeholder group.

TASC
Students have freedom of choice when they are allowed to define the task (Identify step), and when they Generate ideas, choose criteria to Decide on the best idea, develop their own Implementation plans, Evaluate based on their own criteria, Communicate using a self-selected format, and Reflect on their learning.

DISCOVER
A key principle in DISCOVER is that teachers collaborate with students to establish a learner-centered environment that includes student choice. Another is that students are encouraged to create varied products that reflect their diverse strengths, interests, and preferences.

Group Interaction: Facilitating students’ interaction with each other

PBL
Group interaction occurs naturally because students usually are working together to solve a problem. Although they also can solve problems individually, even then, they present their solutions to a group. Interactions between groups and between presenters and the audience occurs frequently.

TASC
TASC was designed to facilitate thinking and problem solving in group settings. Although much of the model could be used by an individual working alone, the Communication step requires interaction in some way with some audience.

DISCOVER
This principle is not specifically addressed in the DISCOVER model, but should be included by having students use the TASC model, especially when solving Problem Types V and VI.

Pacing: Giving information at appropriate speeds and allowing in-depth investigations

PBL
When students are developing their solutions to problems in PBL, they are self-pacing in that some may gather a lot of information while others gather less, and some may gather information
at more advanced levels than others. Teachers also can influence pacing through their introduction of concepts and skills at higher or lower levels depending on student interest and ability.

**TASC**

In the *Gather and Organize* step of TASC, students list what they already know. This enables the teacher and the other students to avoid re-teaching certain information. They also list what they want or need to know, so this helps to focus both the efforts of the small groups and the teacher’s presentation of important information to the group. Pacing also is part of the group work because individual group members can focus on areas of expertise or areas of need, and can gather information or develop skills at their own paces. Another way appropriate pacing occurs is through student choice of groups. They may choose groups of like-minded peers or those of a similar ability level.

**DISCOVER**

One of the ways the DISCOVER curriculum model has been implemented is to have classroom or school learning centers where the students can spend time exploring areas of interest. In these centers, they can pace their acquisition of new information, choose the types of problems they solve, and spend as much time as they need on a particular project or activity.

**Variety: Using a variety of processes**

**PBL**

This principle is not a specific part of PBL, but often occurs because students are using a variety of processes due to their appropriateness for the particular problem.

**TASC**

In the TASC wheel, a variety of processes are incorporated because each step has a different thinking focus. At the Implement step, a variety of processes may be essential.

**DISCOVER**

Variety is a part of DISCOVER: focusing on Multiple abilities, modeling and using a variety of processes, and solving varied problem types.

**Product principles: The products students create or develop**

**Result from real problems: Problems are real and not contrived**

**PBL**

This principle is one of the most important in PBL. Students work to resolve problems that are real in their own lives, in their communities and regions, and in the world.

TASC
This principle is not addressed in the TASC model, but it can easily be incorporated by combining TASC with PBL.

DISCOVER
This principle is not addressed in the DISCOVER model, but it can easily be incorporated by combining DISCOVER with PBL.

Addressed to real audiences: Audiences are appropriate for developmental levels

PBL
Results of PBL experiences often are delivered (in the form of a report), or presented (in various forms such as a talk, poster, PowerPoint presentation, movie, or other method) to an audience interested in the solution. Young children may present to peers, parents, and students in other classrooms rather than an audience in the community.

TASC
Teachers who implement TASC usually arrange ways for students to communicate to audiences interested in their products. However, the audience may be only the other students working on the same or a similar task. This principle is incorporated by combining TASC with PBL.

DISCOVER
This principle is not explicitly stated in the DISCOVER curriculum, but often is incorporated due to the need for students to share their products and to demonstrate their strengths in Multiple abilities.

Transformation: Products are original to the student and synthesized, not compiled

PBL
During PBL experiences, students view information from a variety of perspectives, reinterpret information, elaborate on information, extend it, and go beyond the information to create unique solutions. If stakeholder groups solve the problem, they present the solution from a perspective other than their own.

TASC
When students begin the steps of TASC by recalling what they know, then generating ideas, choosing the best idea, and implementing this idea, the entire process involves transformation. Because they have implemented their own ideas and developed their own products, their creativity is enhanced.
DISCOVER
A key principle in DISCOVER is that the teacher models a variety of processes and then gives students opportunities to use these processes to access and transform information. When students solve the open-ended problems they are practicing transformation.

Variety: Students produce a variety of products

PBL
Variety can be easily incorporated into the products of PBL experiences by encouraging students to think of different ways to present their solutions.

TASC
The TASC model lends itself well to the development of a variety of products because students choose different ways to implement their solutions and find different ways to communicate with their audiences.

DISCOVER
Students are encouraged to produce varied products that reflect their diverse strengths, interests, and preferences. This is a key principle in the DISCOVER curriculum model.

Self-selected format: Students choose the formats of their products

PBL
Students are given the option during PBL experiences to self-select the format of their products based on their interests and abilities as well as the potential effectiveness of the product in solving the problem or convincing the audience of the validity of their solutions.

TASC
When the TASC model is used, students are encouraged to select the format of their solutions and the ways they communicate with their audiences.

DISCOVER
Multiple abilities are incorporated through self-selected product formats. Students can choose to produce a drawing (spatial), a poem (verbal), a diagram (mathematical), a play (bodily kinesthetic), or any other product that demonstrates their learning or solutions to problems.
Appropriate evaluation: Evaluation is based on clear, identified, appropriate criteria

PBL
This principle is not a part of the PBL model, but can be incorporated easily through self, peer group, and audience evaluation using criteria developed by the students or cooperatively by the students and teacher.

TASC
The TASC model incorporates appropriate evaluation when students generate their own criteria and apply these criteria to choose the best solution, and when they generate their own criteria for evaluating their implementation. Teachers can become involved in the evaluation process by developing criteria cooperatively with the students.

DISCOVER
This principle is not a part of the DISCOVER model, but can be incorporated easily through self, peer group, and audience evaluation using criteria developed by the students or cooperatively by the students and teacher, and by using the TASC model.

Learning environment principles: The context in which learning occurs

Learner centered: Centered on students rather than the teacher or the expert

PBL
Students solve problems and the teacher is the facilitator of the process. In some cases, the teacher determines the problem situation, but students solve the problem themselves.

TASC
TASC is learner-centered in several ways: students begin with the information they have, generate ideas, choose the best idea, implement their idea, evaluate their implementation, and reflect on what they learned. The process becomes more or less learner-centered based on how the teacher handles the Identify step. If students truly identify their own tasks, it is more learner-centered than when the teacher asks all students to complete the same teacher-defined task.

DISCOVER
When using DISCOVER, teachers are expected to establish a learner-centered environment that includes flexible scheduling and grouping, standards for behavior, sharing, openness, and acceptance.
Encourages independence: Designed to help students become independent learners

**PBL**
Students are encouraged to solve the problems in their own ways and to add their unique voices to the solutions. They also are encouraged to identify problems that are important to them.

**TASC**
Students are taught a process. They can apply the steps in TASC independently to any problem or task and in any academic or social context.

**DISCOVER**
When teachers use the DISCOVER model, students are encouraged to design their own problems, to select the format of their products, and produce varied products that reflect their individuality.

Openness: Open to new ideas, varied processes, and new information

**PBL**
Openness needs to be incorporated by inviting experts to speak to the class, and by encouraging students to explore multiple sources and develop their own solutions.

**TASC**
This principle is not addressed in the TASC model, but teachers need to incorporate new and different materials, invite speakers, and assist in locating varied sources to support the students as they generate ideas, implement them, and develop ways to communicate them to an audience.

**DISCOVER**
Openness is considered to be an important aspect of a learner-centered environment in the DISCOVER model. Teachers demonstrate openness through posing semi-open and open problems, encouraging students to design products reflecting their interests, cultures, preferences, and multiple abilities.

Accepting: Accepting of varied perspectives and all students’ ideas

**PBL**
This principle is incorporated if the teacher does not reject well-documented and researched solutions proposed by any student or group of students even when different from what the teacher believes is the best solution.
TASC
When implementing the TASC steps, teachers need to encourage students to share all their ideas at the Generate step and to implement the solutions they have chosen.

DISCOVER
Acceptance is considered to be an important aspect of a learner-centered environment in the DISCOVER model. Acceptance is demonstrated through the teacher’s willingness to involve students in developing standards for behavior in the classroom, accepting their ideas and solutions, and respecting their cultural traditions and values.

Complexity: Including varied and complex resources and multiple tools

PBL
The model does not include specific ways this principle can be implemented, but if students work in the community setting and collect authentic data, they will be in a complex environment.

TASC
This principle is not addressed in the TASC model, but it can easily be incorporated by combining TASC with PBL and DISCOVER.

DISCOVER
Complexity in the learning environment is a part of the DISCOVER model due to the emphasis on multiple abilities. Students are to be given access to the tools of all the abilities and academic disciplines.

Varied groupings: Students work together in various ways, including by choice

PBL
Although not addressed in the model itself, students should work in different groups over time. One way to do this is to give students choices of stakeholder groups or aspects of a problem situation of interest to them.

TASC
When teachers use a variety of types of groupings (ability, choice, interest, random assignment, whole group), allow individuals to work alone, and change groupings periodically, this principle is incorporated.

DISCOVER
Flexible scheduling and grouping are considered to be important aspects of a learner-centered environment in the DISCOVER model. Flexibility is demonstrated through grouping students
according to interests, multiple types of abilities, and preferences, as well as in allowing students to work individually.

**Flexibility: Timing, grouping, and methods are flexible**

**PBL**
Flexibility is essential when implementing PBL. Students need time to engage in their problem solving processes, and may need extensions of time if they become highly engaged and wish to investigate a problem in more depth than the teacher anticipated. They also may need flexibility due to inability of group members to work together effectively.

**TASC**
Flexibility is necessary to accommodate the range of interests and strengths within the groups. When this principle is incorporated into the TASC model’s implementation, students are more enthusiastic, more motivated, learn more, and retain information longer. They resist the work less when they are given flexibility because they are enjoying their choices and engaged in their learning.

**DISCOVER**
Flexible scheduling and grouping are considered to be important aspects of a learner-centered environment in the DISCOVER model. One of the ways this occurs is through learning center time in which students have very few time constraints, and can work on a project over time. They are given many choices of problem types, multiple abilities, and product formats.

**High mobility: Students move in and out of the classroom and within the classroom**

**PBL**
The freedom to do fieldwork at the problem site, to invite speakers on topics related to problem solving, and to work in laboratories or libraries is essential to PBL success.

**TASC**
High mobility is not addressed in the TASC model, but it can easily be incorporated by combining TASC with PBL and DISCOVER.

**DISCOVER**
When students design the format of their products, use a variety of processes to access and transform information, and develop abilities in a wide range of areas, they must be allowed the freedom to access materials and tools within and outside the classroom.
Research demonstrating the validity of the component models

Was the model developed using appropriate methods?

PBL
Problem-based learning was first developed for use in medical schools, and was later adapted for use in elementary and secondary schools. The purpose was to change the structure of curriculum and instruction through (a) having an ill-structured problem as a unit of study, (b) requiring students to solve the problem from multiple perspectives, and (c) focusing instruction on metacognition and self-reflection (Gallagher, 2009). Each of these elements was tailored to develop specific knowledge, skills, and dispositions while ensuring students learned required content (Hmelo-Silver, Duncan, & Chin, 2007).

TASC
Development of TASC began with a review of various theories, particularly those of Vygotsky and Freire. Freire’s emphasis was on meeting the needs of learners within their particular contexts, while Vygotsky’s was on social and cultural transmission and construction of knowledge as a fundamental vehicle of education. Included also in this framework was Robert Sternberg’s metacognition, the processes that are used to plan, monitor, and evaluate strategies used in problem solving. Many different problem solving programmes and the research on their effectiveness was reviewed and the essential components were included in the trial model. It was tested in many schools and contexts before it was finalized (Adams & Wallace, 1991; Wallace, 2008).

DISCOVER
Starting with a modification of the continuum of problem types used in the research on creativity by Getzels and Csikszentmihalyi, Maker and Schiever tested the problem continuum with adult males and females and boys and girls. One group was those who were nominated as highly competent in each of Gardner’s Intelligences and the other was those who were competent in each of the intelligences. Maker and her colleagues found that people prefer to solve problem types V and VI in their areas of strength and they prefer problem types I and II in their areas of weakness (Maker, 1993). Then, Maker and her colleagues educated a group of teachers about problem types and multiple abilities. Those teachers used what they learned with different cultural groups and ages of students. A list of key principles was derived from extensive observation of these teachers; these principles form the basis of the model (Jo & Maker, 2011; Maker, et.al, 1996; Maker, et.al, 2006; Maker, et.al, 2008).
What research is available to show the model’s effectiveness as an approach for use with gifted students?

PBL
Gifted students enrolled in a problem-based science and society course were more proficient in “problem finding” and engaged in problem solving more successfully and spontaneously than the comparison gifted students (Gallagher, Stepien, & Rosenthal, 1992). A PBL study in science showed that gifted students deepened their understanding of scientific knowledge and development of creativity as well as problem solving skills (Jo & Ku, 2011). PBL was found to be an effective instructional strategy for high ability and gifted elementary school children. Results showed significant differences among treatment groups across time for both math achievement and science process skills (Inman, 2011).

TASC
In a 14-year project to develop and test the effectiveness of the model, with KwaZulu students in their Apartheid Homeland, the purpose was to develop a range of appropriate thinking skills to promote self-esteem, independence, and empowerment; and to design curricula that were relevant to, and contextualized in, Zulu culture. The 28 students in the first pilot TASC Project all gained the highest results ever achieved among Black students in KwaZulu/Natal in their Senior School Certificate. All students entered universities with scholarships to pay their fees and support their studies. In a follow-up meeting, all 28 students said the first thing they had done at the university was to set up a TASC club so that they could teach fellow students the problem-solving and thinking strategies they had used to master their studies (Wallace, 2008).

DISCOVER
Alhusaini and Maker (2011) reviewed 20 articles about open-ended problem solving. Most of them were about the effectiveness of the DISCOVER model. The authors concluded that the use of open-ended problem solving was effective and useful in developing creativity, content knowledge, and other important skills. All of the groups included identified gifted students, and the results were reported separately for gifted students in some studies. If students participated in classrooms in which the model was being used for at least two years, their gains were greater, showing the cumulative effects of the approach (Maker, et.al, 2008).

What evidence is available to indicate that the model is structurally sound or theoretically valid?

PBL
PBL is open ended, but structured. Activities have two different structures; (a) the flow of activity during a unit moves from inquiry and investigation to problem explanation, and then to problem resolution and debriefing; and (b) the problem itself is a scenario that leads to a logical conclusion of the unit. In addition, the students and teachers have considerable leeway to choose methods of investigation, forms of analysis, decision making strategies, and other problem solving methods (Gallagher & Horak, 2011). PBL offers a structure in which the problem presented to
students can be open-ended enough to generate creativity and interest while still providing guidance in the selection of a problem to investigate (Jo & Ku, 2011).

TASC
Much of TASC’s theoretical basis is from Vygotsky’s theory and evidence showing that higher levels of human cognition are developed in an inter-personal context. The structure of the model and the progression of the steps also is supported by many recent information processing theories of intelligence, which include sequences such as problem solving using local or innate knowledge, connecting this to new knowledge, and using thinking schemes or rules to process knowledge, and then to reflect on the process, the learning, and the knowledge (metacognition). An important part of the structure is to communicate results to an audience, which ensures that learning goes beyond the immediate small group in which the students work (Adams & Wallace, 1991; Wallace, 2008).

DISCOVER
Maker’s (1993) initial studies showed that the problem continuum was a valid way to engage both children and adults in problem solving across multiple abilities. A later study showed that the structure of the problem continuum was appropriate. Sak and Maker (2005) found that correlation between scores across problem types varied according to their proximity to each other. In other words, performance on Type I had a higher correlation with performance on Type II, and progressively lower correlations with performance across the problem types, with the lowest correlation being between the closed problems (I) and those that were open ended (VI).

Is the approach defensible as a qualitatively different programme for gifted students?

PBL
PBL is focused on problem-solving for gifted students. When used in an academic setting for gifted students, it provides a context in which knowledge and skills deemed important in a discipline are applied in a real-life situation, thus integrating the traditional analytic and synthetic abilities with practical ones (Maker & Zimmerman, 2008). PBL is considered by many authors to be one of the best ways to develop problem solving in gifted students, as evidenced by the many curricula with it as a basis.

TASC
TASC was developed to facilitate the problem solving process for gifted students, and has been used consistently in programmes for gifted students in a variety of settings, and in many different countries. Gifted learners helped to develop the TASC Framework through active, practical, hands-on, everyday problem-solving activities to solve problems they identified as personally relevant (Maker & Schiever, 2005).
DISCOVER
Although all students in the general education classroom might benefit from implementation of the DISCOVER model, it was developed specifically as a way to meet the needs of gifted students in a variety of settings, which included general classrooms, special classrooms, special programmes, and special schools (Maker & Schiever, 2005). Extensive observations of teachers and analysis of results demonstrated its effectiveness (Maker, et.al, 1996; Maker, et. al, 2006; Maker, et. al, 2008).

Conclusion
In this article, we have analyzed the REAPS model, evaluating it as an approach that can be used to provide a comprehensive curriculum for gifted and talented students. Based on our experience and the research we have been conducting, we believe it can be used in any setting, with any age group of students, and with any curriculum framework. Because it has as its basis the development of the ability to solve real problems in a creative way, it is an approach that can be used with all students in ways that connect them to their communities: the environment, the animals and plants, and the people in them. We believe using the REAPS model is a way to develop and build on the passions and interests of gifted students and their desire to give back to the world in ways that make it a better place to live.
References


