Advancing the Transformation of Education Through Team-Based Learning

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Abstract

Team-based learning (TBL) is a widely practiced pedagogy focused on teamwork and active learning. In TBL, students are provided with opportunities to apply conceptual knowledge through a sequence of activities that includes individual preparation, teamwork, immediate feedback, and continuous assessment. Process Education offers 14 aspects for the Transformation of Education (ToE), a framework for understanding educational influences on growth. Each aspect explores internal and external pressures that impact the transformation of teaching and learning. TBL systematically advances many positive features of the 14 aspects of the ToE. This article seeks to explain the process and considerations of implementing TBL through the lens of the ToE, showing how each of the TBL steps map to the desired states of the ToE. Likewise, the 14 aspects of the ToE outline common educational pressures that limit growth, serving as guidance for improving the execution of TBL and revealing the synergy between TBL steps. A stepwise TBL flowchart and table connecting TBL to the ToE 14 aspects is provided to support process educators, offering an integrated approach to elevate teaching and learning through its application. This work serves as the first focused exploration integrating both TBL and ToE educational frameworks.

Introduction

Seeking excellence in teaching and learning is complex, with a wide variety of pedagogical approaches discussed in the literature and promoted by centers for teaching and learning. Each approach is influenced by factors including learner profiles and buy-in, educational structure and environment, resources, expertise with the method(s), and cultural pressures. Process Education (PE) is a performance-based philosophy of education which integrates many diverse educational theories, processes, and tools. PE emphasizes the continuous development of learning skills through assessment to produce greater learner self-development (Beyerlein et al., 2007). Similarly, team-based learning (TBL) is a highly interactive learner-centered approach to teaching and learning that provides students with well-designed learning materials, challenging problem-solving activities, and regular opportunities to learn and work with peers. TBL encourages students to apply their learning through a sequence of activities focused on individual preparation, teamwork, and immediate feedback (Parmelee et al., 2012).

The TBL method, as depicted in Figure 1, includes four phases with eleven steps (Michaelsen & Sweet, 2008, Michaelsen & Sweet, 2011, Michaelsen et al., 2014; Parmelee et al., 2012, Parmelee et al., 2017; Burgess et al., 2020). The four phases depicted in Figure 1, are *Orientation, Readiness Assurance Process, Team Application Phase,* and the *Evaluation Phase*. The two steps within the orientation phase include introducing TBL to the students and building teams with roles for each team member. Within the readiness phase there are five steps including, pre-class readiness assignment, pre-class learning, conducting the in-class formative assessments with an individual readiness assurance test (iRAT) and a team readiness assurance test (tRAT), in-class instructor clarification and review, and out of class team appeals and instructor feedback. Two steps are included in the team application phase. The first is the in-class team application activities and active discussion within each team. This step concludes with the teams then simultaneously reporting their answers to the class. The second step in this phase is the class discussion of each application and wrapped up by end of session with a class debrief. The evaluation phase is last and includes self and peer evaluation on teamwork and learning performance and summative assessments including exams and rubric-based performances. The goal across these phases and steps is to create a student-centered, active learning focused classroom with a quality learning environment.

One area of intersection between TBL and PE is the Transformation of Education (ToE; Hintze-Yates et al., 2011). TBL elevates many of the 14 aspects from the ToE by focusing on developing and improving classroom learning, collaborating, teaching, applying, decision-making, and leadership. Through the elevation of these aspects, TBL has the potential to advance the practice of PE and PE has the potential to elevate the implementation of TBL.

The ToE describes the potential for positive transformation of every individual and institution involved in the educational process. There is opportunity for movement and improvement from historical trends (red) to emerging

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Figure 1 Summary Flow Chart of the TBL Phases and Steps
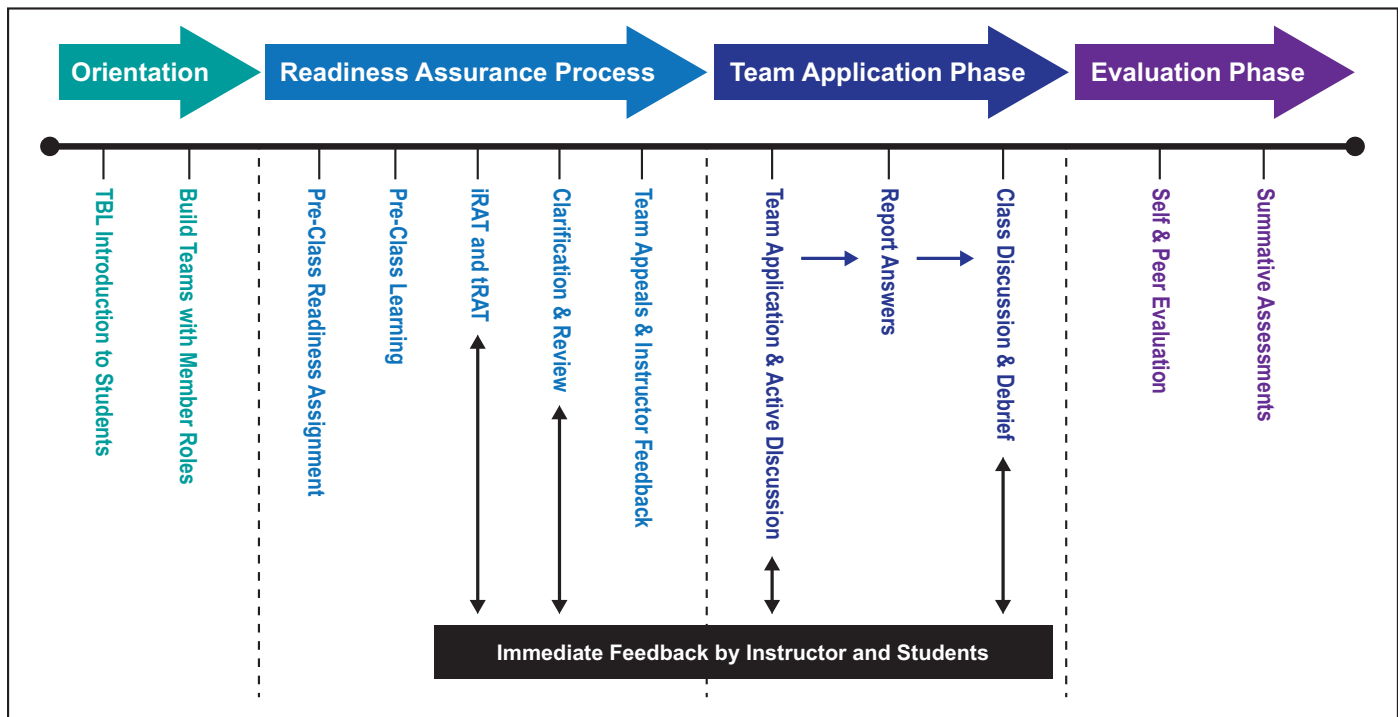
practices (yellow) to future directions (green), achieved through a continuous process that encourages individual growth and awareness of growth in others (Hintze-Yates et al., 2011). The 14 aspects of the ToE, listed in Table 1, serve as mediators of quality in teaching and learning in higher education (Beyerlein et al., 2012). These 14 aspects offer a framework for understanding and responding to both internal (largely academic and pedagogical) and external (largely economic and cultural) pressures for positive transformation in teaching and learning. Students, faculty, and administrators can use the ToE to reflect and explore opportunities and barriers impacting growth across educational settings, including institutional cultural and individual characteristics, with tips for elevating the aspects of challenge, cognitive complexity, control, delivery, design, efficacy, feedback, measurement, ownership, relationship, scope of learning, self-awareness, social orientation, and transparency. Characteristics and cultural pressures for each aspect are described to help understand tendencies across academic settings, with tips proposed for moving from red to green within each aspect (Hintze-Yates et al., 2011). These 14 aspects, their definitions, and the tips moving from the historical tendency to the future direction provided by Hintze-Yates et al. (2011) are delineated in Table 1.

Origins of the Transformation of Education

As an integral part of its efforts to make credible and accessible the promise of transformed practice through PE, the *Faculty Guidebook* (FGB; Beyerlein et al., 2007) offers comprehensive tools for helping faculty, staff, and administrators define and synergistically develop teaching and learning practices. The FGB contains four development sections (Institutional Development, Intellectual Development, Learner Development, and Self Development) with more than 150 modules. These modules are based on research and scholarly thinking and provide practical suggestions and references for faculty to apply in their own settings (Beyerlein et al., 2007). The 14 aspects of ToE were created by a collaboration of prominent PE authors to effectively implement the philosophy and precepts of PE (Reflections, Pacific Crest, 2009-2010) and to identify the most relevant, informative, and efficacious *Faculty Guidebook* modules. These include critical thinking, learning environment, assessment and evaluation, learning taxonomy, learning to learn, and lifelong learning with each module linking to select ToE aspects. These aspects lead to measurable and observable system-wide success, demonstrating how education should work and how improved performance can be realized on the part of learners, educators, and administrators (Hintze-Yates et al., 2011).

While the areas of critical thinking, learning environment, assessment and evaluation, learning taxonomy, learning to learn, and lifelong learning are supported by modules within the *Faculty Guidebook*, they are also expanded upon in the scholarship within the International Journal of Process Education (IJPE). A brief discussion of each of these areas follows.

Table 1 The ToE 14 Aspects Definitions and Descriptors for Red, Yellow, and Green

Aspect	Definition	RED (Historical Tendency)	YELLOW (Emerging Practice)	GREEN (Future Direction)
Challenge	The degree to which increasing the level of difficulty is used in order to grow capacity for learning and performing	Enabling	Pushing	Empowering
Cognitive Complexity	The degree to which training and doing is elevated to problem solving and research	Memorizing	Understanding	Problem solving
Control	The locus of power and authority for the learning situation or experience	Faculty-centered	Learning-centered	Learning-centered
Delivery	The means by which information or knowledge is obtained by learners	Presentation	Discussion	Active learning
Design	The purposeful arrangement of instructional environment, materials, and the experiences to support learning	Rigid	Modular	Responsive
Efficacy	The well-founded belief in one's capacity to change and to make a difference	Doubt	Willingness to try	Conviction
Feedback	The information about what was observed in a performance of work product	Evaluation	Progress report	Assessment
Measurement	The process of determining the level of quality of our performance or product	Subjective determination	Categorical determination	Objective determination
Ownership	The degree to which the learner accepts responsibility and accountability for achieving learning outcomes	Directed	Guided	Self-directed
Relationship	The degree of emotional investment an instructor or mentor has in his or her students or mentees	Emotionally distant	Emotionally available	Emotionally invested
Scope of Learning	The contexts across which learning occurs and its application is demonstrated	Situational understanding	Disciplinary understanding	Interdisciplinary understanding
Self-Awareness	The degree to which reflective and self-assessment practices are used by the individual to foster the growth of his or her learning skills across the cognitive, affective, and social domains	Self-consciousness	Self-regulation	Self-growth
Social Orientation	The investment, interdependence, and responsibility for learning throughout a community	Individual	Collaborative	Community
Transparency	The degree to which stakeholders can view individual, team, or collective performances	Private	Limited exposure	Public

Critical Thinking

Critical thinking is the ability to use and manage intelligence and skills for tasks or goals in application. Critical thinking is the competency to analyze, synthesize, and evaluate information and arguments, and to apply these skills to various disciplines and situations. As Bobrowski and Cox (2007) note, "Critical thinking supports the creation of new knowledge, or improved quality of knowledge, in any field or application." The authors also discuss the importance of critical thinking for faculty and students and provides strategies and resources for developing and accessing critical thinking skills (Bobrowski & Cox, 2007; Watson, 2007).

Learning Environment

In Creating a Quality Learning Environment (1994), the authors describe a quality learning environment as one characterized by respect, trust, openness, high expectations, support for risk-taking, a willingness to challenge performance, continuous assessment, and a growth-oriented mindset for everyone. An effective learning environment has a strong impact upon a person's growth, development, and performance. Faculty must create an environment which allows for greater student ownership, responsibility, and control of the learning process (Apple & Smith, 2007; Apple et al., 2016a).

Assessment and Evaluation

Assessment and evaluation are processes used for improving quality and judging quality, respectively. An assessment is an analysis of current performance, aimed at improving future performance by clarifying the reasons behind current performance strengths, determining potential improvements, implementing action plans for achievement, and gaining insights and learning from each performance (Baehr et al., 2007; Apple et al., 2016b, 2016c).

Learning Taxonomy

Learning taxonomy presents a framework for classifying and organizing learning and learning outcomes. The most well-known, Bloom's Taxonomy, outlines the six levels of cognitive domain from lower-order to higher-order thinking skills: knowledge, comprehension, application, analysis, synthesis, and evaluation. Bloom's taxonomy differentiates cognitive skill levels as well as the learning outcomes that require higher levels of cognitive skills, leading to deeper learning (Adams, 2015). The Revised Bloom's Taxonomy (remember, understand, apply, analyze, evaluate, and create) describes the actions of the learner at progressively deeper levels of learning (Anderson et al., 2001) which many faculty use when developing learning outcomes. The *Bloom's Taxonomy — Expanding its Meaning* FGB module expands the usefulness of Bloom's taxonomy beyond its original intent, to help faculty prepare better-designed courses, achieve more student-centered implementation, and establish outcomes-oriented evaluation criteria (Bobrowski, 2007).

Learning to Learn and Lifelong Learning

Learning is a foundational skill in PE, important for continuous growth and improved performance. Lifelong learning is one of the key outcomes for any educational program that deals with continuously and rapidly changing professional practices. In recognition of its importance, lifelong learning is considered one of the specified outcomes for accreditation of many professional programs (El-Sayed & El-Sayed, 2014).

Faculty Development

PE is an educational philosophy that integrates several educational theories, methodologies, and tools to support continuous improvement of learning skills and self-development. The PE model of faculty development is a comprehensive and systematic approach to improving faculty performance in various contexts of education and development. It also explains the four levels of faculty performance, from novice to master, and the corresponding competencies, skills, and attributes that faculty need to develop and demonstrate at each level assessment (Beyerlein et al., 2007; Apple et al., 2016d).

Connecting TBL to the Transformation of Education

TBL studies have shown that course facilitators can significantly influence team climate and further influence personal thinking and wellness (Michaelsen et al., 2004; Zhou et al., 2021). In TBL, an instructor applies backward design to help learners work up Bloom's taxonomy levels of complexity as they move from individual preparation (remember, understand), to team applications (apply, analyze), to class discussion and comparison of rationales (analyze, evaluate, create) (Adams, 2015). The instructor also applies TBL processes to foster and improve students' accountability for their pre-class readiness assessment, team engagement, collaboration and communication skills, and critical thinking ability so they can apply knowledge and skills to analyze and solve significant real-world problems professionally.

From TBL literature, we can see there are several essential elements: strategically formed teams, readiness assurance, 4-S application activities (Michaelsen & Sweet, 2008), and peer evaluation. When designed and delivered

effectively, TBL provides an active and structured form of small group learning, develops student accountability, improves students' preparation and engagement for the in-class session, and is an effective tool to overcome the passive engagement limitations of conventional classrooms (Michaelsen & Sweet, 2011; Parmelee et al., 2012; Allen et al., 2013; Burgess et al., 2020; Sannathimmappa, 2022). TBL takes advantage of human psychological memory formation, learning by consolidation then reconsolidation of knowledge via the TBL steps. Assigning a few hours of guided learning of new material independently (pre-class readiness) days before class enables initial consolidation of knowledge during sleep. Students then come to the classroom for reconsolidation exercises via iRAT, tRAT, team applications with immediate feedback from teammates, exploration and discussion of reasoning and viewpoints, concluding with instructor closure with key points and review. Thus, the effects of the TBL reconsolidation activities on learning and memory are retrieval practice, peer elaboration, feedback, and transfer (Schmidt, 2019).

The backward design approach (Bowen, 2017) systematically elevates learning across the TBL module. This approach requires instructors to consider the learning outcomes and target performances first, then design assessments and applications, and lastly, develop pre-class readiness learning materials that emphasize the most critical areas of content (must know) and address important secondary content (good to know). With the learners' target performances in mind, instructors write measurable key learning outcomes then align exam questions across multiple levels of Bloom's taxonomy. They may supplement with additional measures of performance through rubrics, essays, presentations, and reflections. Guided by the learning outcomes, instructors prepare learning materials aligned to the knowledge, skills, and mindsets that they desire their students to master. In turn, students learn and progress from lower to higher-learning cognition levels across Bloom's Taxonomy (Bobrowski, 2007). Engaging in and conducting faculty development in TBL design and facilitation will help with understanding the TBL method, problems solving common barriers, and standardizing the delivery and expectations across instructors (Burke, 2007). A good balance between structure and flexibility is necessary for effective TBL implementation. Nationally, the Team-Based Learning Collaborative has these resources to support development at the individual or local level.

An analysis of each phase and step of TBL demonstrates the broad alignment of with the 14 aspects of the ToE. This analysis showcases how TBL addresses multiple dimensions of the ToE, from challenging students, to fostering relationships and promoting self-awareness. After a thorough review of PE and TBL literature, no other pub-lication explores team-based learning and ToE to link the frameworks. Aligning TBL steps to the published ToE tips (Hintze-Yates et al., 2011) within each of the 14 aspects whenever possible offers insight into the application of PE and serves as a useful reference for both TBL and PE practitioners seeking to elevate teaching and learning practices.

Phase I: Orientation

Step 1. TBL Introduction to Students

Students should be prepared for TBL methodology before using TBL for teaching and learning. The focus in this step is to ensure student buy-in to the new processes of the TBL pedagogy. Students often expect, to their detriment, that they will need to start learning from a teacher's lecture. Therefore, they often initially feel an increased workload when using TBL because they must now do the pre-class preparation prior to class time in anticipation of the readiness assurance testing (iRAT, tRAT). There are also peer expectations to contribute to team problem-solving activities and class discussion. This pre-class preparation and in-class application means less time is required after class reviewing material. In essence, study time is shifted forward. There is also less dependance on the *binge and purge* approach to studying that many learners attempt before exams, often with suboptimal results. Common approaches to introducing TBL include assigning students to read an article or watch a video about TBL out of class and/or introducing TBL to students during class on the first day of the course.

There are multiple strategies to successfully achieve student buy-in. The first strategy is introducing the full TBL process before learners are asked to learn with TBL. At least one week prior to the first day of the class, post the TBL introduction handout with a link to a video about the TBL process. Assign the students to read the handout and watch the video outside of class

A second strategy is early non-graded practice RATs and applications to help reduce tension around grades. To accomplish this, on the first day of class, students watch the video together again, and then follow with the practice non-graded iRAT and tRAT. After, facilitate a discussion to provide clarification of the key areas of misunderstanding. Then offer a team application, and a whole-class discussion and debrief. By the end of this strategy, the students will have experienced many of the steps in the TBL process, the tools (including software and reporting techniques), and the overall benefits.

The final strategy is to support a quality learning environment for students through clear expectations and planning based on the TBL process. The instructor needs to manage pre-class workload expectations to calibrate the amount of

preparation in which students need to engage and provide clear early communication and reminders to help students complete pre-class assignments.

Challenge *Mapping to the ToE*

The instructor clarifies TBL concepts, steps, and differences from other learning-teaching methods which can be mapped to the empowering descriptor of Challenge. The relevant ToE tip is *Maintain expectations for learners, even in the face of learning adversity (use tough love; personal factors exist but can't be used to lower expectations)* (Hintze-Yates et al., 2011). The introduction of TBL sets a clear expectation that students must do pre-class learning prior the class time. Thus, students are ready for the iRAT and to contribute to team discussion. This tip can assist in moving to the empowering elements of challenge, such as being self-directed learners and problem-solvers. TBL can help students achieve unrealized potential, which can lead to life-long learning.

Self-Awareness *Mapping to the ToE*

The introduction of TBL can also be mapped with the Self-Awareness aspect of ToE. The introductory process is designed to promote a self-growth mindset in students. This introductory process maps well with ToE Self-Awareness tips of modeling the use of self-assessment and using learning activities to build learning skills. The TBL introduction sets the stage for self-growth, showing the importance of learning how to learn, self-discipline, and self-development.

Step 2. Build Teams with Member Roles

The teams are strategically formed at the beginning of the semester, each typically with 5 to 7 students (slightly smaller if creating online teams). Effective teams may be formed by diversifying across a desired characteristic or experience, or simply creating randomly, but not by student self-selection. Teams are permanent and stay intact across the whole semester or academic year.

Team member roles are adapted from PE (Smith, 2007). The person in the Captain/Chairperson role will make sure that the team completes assignments on time and team members demonstrate professionalism (i.e., respect, appearance, behavior, communication, and responsibility). The team member in the Editor/Recorder role takes notes during team discussion and ensures team assignment submissions are concise, coherent, and complete. The Spokesperson role represents and shares team ideas, rationale, and solutions to problems publicly when asked. The Coach/Counselor team member role encourages the team to work together cohesively and solves conflicts.

The person in the Quality Assurance role focuses on the quality of teamwork and work products and leads regular process of improvement discussions. The Role Reminder team member reminds and supports the team to ensure the above roles are executing and improving. Faculty may encourage individual team members to take turns leading in different roles.

Ownership *Mapping to the ToE*

Building teams with team member roles can be mapped with the *Ownership* aspect of ToE. TBL teams are inherently heterogeneous and require a diverse set of skills to successfully operate. During a semester, ensuring team members experience different roles allows them to work collectively towards shared outcomes and self-regulate. The team and role assignment maps directly to the ToE tip, *Assign students to heterogeneous teams when diverse skills are needed to tackle difficult learning challenges* (Hintze-Yates et al., 2011). The TBL instructor also asks students to commit to communication and cooperation, often through team contracting on the first day of the course. Students become intrinsically motivated to learn and become self-growers by taking on more ownership. Team assignments require students to actively engage with others and to solve scenarios based on authentic problems (Hintze-Yates et al., 2011).

Efficacy *Mapping to the ToE*

Building teams with member roles can be mapped with the Efficacy aspect of ToE. Each team member is accountable to their team and has a significant impact on the team's success. Thus, team members must accept authority and accountability for what happens around them. Each team role provides an opportunity for personal and community growth (Hintze-Yates et al., 2011).

<div style="background:#1f6fc4;color:white;text-align:center;padding:4px;font-weight:bold">Phase II: Readiness Assurance Process</div>

Step 3. Pre-Class Readiness Assignment

A content expert (typically the instructor) prepares pre-class readiness learning materials, using a backward design approach and Bloom's taxonomy to identify and organize learning foundational principles (primarily to remember and understand, with guided examples to help prepare students to apply their learning). Learning materials usually include study guides, prerecorded presentations with slides, written handouts, practice problems, homework activities, select textbook chapter elements, relevant sections of guidelines, or short articles from the literature, all with sufficient explanation and guidance to ensure learners will be able to engage and understand the material on their own before class. Materials are organized in a step-by-step

manner to help support learning basic concepts and skills, so students may recall the foundations and then effectively apply the learned principles to problems in class.

TBL backward design process may be very time-consuming for new instructors. TBL modules require the development of learning outcomes, then preparing evaluations and assessments for learning, then learning materials that introduce concepts and develop higher order thinking and performance. This may include daily handouts, RAT questions, and 4-S team application activities (Michaelsen & Sweet, 2008) with preplanned strategies for facilitation and feedback. In practice, the instructor should start early to prepare for topics for the next semester, utilizing a backward design strategy to create the topic module with clear and measurable outcomes and transformative team application activities that elevate student thinking up the hierarchy levels of Bloom's taxonomy in ways that are relevant to learners' future performance or professional career. After preparing all learning materials including handouts, RAT questions, and applications, the instructor considers developing and practicing the lesson plan including a timetable for in-class delivery and facilitation strategies. Adjust this lesson plan to reflect the appropriate pace for the typical learner and time allotted.

Especially important for instructors new to TBL, designers must create a reasonable number and complexity of team application activities to effectively practice the learning outcomes during the in-class session within the time allotted. Building flexibility into the lesson plan and ordering the applications so that some can be skipped will allow for deeper discussion of key activities rather than rushing through material at a surface level of complexity.

Design   *Mapping to the ToE*

Backward design can be mapped with the *Design* aspect of ToE. There are a variety of ways to develop learning materials provided that the core learning outcomes are met. Content must be relevant to students' current knowledge and their long-term academic and professional success. TBL instructors leverage ToE tips by integrating process and content elements around compelling contexts to develop learning activities that students do in and out of class. All these learning opportunities prepare students to show what they have learned and to apply critical thinking to solve significant real-world problems.

Control   *Mapping to the ToE*

Preparation of pre-class readiness assignments can be mapped with the Control aspect of ToE. The ToE tips for control is *Where appropriate, use digital technology to engage students with course material, inside and out-side of class* (Hintze-Yates et al., 2011). Pre-class assignments help engage students inside and outside the classroom, blending multiple learning modalities, and offers time for learners to explore beyond the assignment. When providing pre-class readiness assignments, the instructors in TBL are focused on instructional effectiveness and view themselves in this step as asynchronous facilitators of learning. By using backward design and digital technologies, they ensure that students are prepared for the foundations of discussion and application of the topic. These practices help to advance the green characteristics and culture pressures of *Control*.

Step 4. Pre-Class Learning

Pre-class learning is an out of class, individual activity. Students receive pre-class learning materials and activities along with pre-class goals, guidance, and rationales with the opportunity to study these materials for at least a few days. Students study these materials asynchronously to get ready for the TBL in-class activities. During pre-class preparation, students are encouraged to search for additional resources, connect with other students, or meet with the instructor before class to help clarify any muddy basic concepts or practices, with additional class discussion and clarification offered after the readiness assurance testing concludes during Step 5.

Challenge   *Mapping to the ToE*

Pre-class learning can be mapped to the empowering descriptor of Challenge. The most relevant ToE tip is *Don't do for students what they can learn to do for themselves* . Students learn the basics of each topic on their own. During the pre-class learning phase, TBL faculty provide guidance on the learning process (the Learning Process Methodology for PE practitioners), systems for notetaking, knowledge self-assessment, and setting the expectation to work together when confronted challenging material or problems. Often, in the beginning of a TBL course, students push back on the required work if they are not buying-in, as it is more preparation than what was expected in prior courses (which is usually none). Later, most students realize the empowering nature of TBL, how it contributes to their personal and professional growth, how TBL fosters life-long learning, and how it saves time preparing for major course evaluations because pre-class and in-class time was used to study and apply learning all along the way.

Ownership   *Mapping to the ToE*

Pre-class learning can be mapped with the Ownership aspect of ToE. Pre-class preparation is inherently self-directed and requires student planning and persistence,

as the learning is asynchronous, and learners have the freedom to explore at their own pace and beyond what is the minimum requirement. Instructors often provide additional optional resources which can further students' self-directed learning. Pre-class learning requires discipline, self-monitoring, and self-regulation. Students quickly learn how they can best tackle these pre-class assignments in ways that make them more effective in class. As students' learning ability improves, learning becomes its own reward.

Control   *Mapping to the ToE*

Pre-class learning can be mapped to the Control aspect of ToE. A ToE tip for Control is *Refrain from doing things for students that they can learn to do for themselves* (Hintze-Yates et al., 2011). TBL is learner-centered, as pre-class learning allows students to independently master the concepts and knowledge that they must know. The student is then ready to discuss and apply the topic material in class.

Step 5. iRAT and tRAT

The TBL readiness assurance tests (RATs) are two interdependent in-class formative assessments to support validate and elevate pre-class learning. The two components of the RAT are the individual readiness assurance test (iRAT) and team readiness assurance test (tRAT). The iRAT is given in-class at the beginning of the TBL session. Each student completes 5 to 10 multiple choice questions in 5 to 10 minutes, closed notes, focused on the foundational concepts that demonstrate readiness to move on to team application problems. Students are not immediately given their iRAT results because the same test will be taken again in teams. The iRAT motivates and offers feedback to students based on their preparation and understanding of pre-class learning.

The tRAT occurs immediately following the iRAT, also in the class, also closed notes. The team takes the same questions as the iRAT, similar time given, and the team must answer each question using discussion to come to consensus. Often software or scratch off cards offer immediate feedback so that teams quickly know if they have chosen the right answer or if they need to try again. Immediate feedback in the TRAT is the key to elevating learning, rewarding teamwork, and improving the team decision-making process over time.

Delivery   *Mapping to the ToE*

Readiness assurance tests can also be mapped with the Delivery aspect of ToE. The iRAT process encourages students to think through their pre-reading material.

The tRAT and later team application process encourage students to engage in critical thinking and discussion, listening to various points of view to determine the best answer for a question. The ToE tips of delivery that map here are *Mix it up* and *Find opportunities for students to prove out* (Hintze-Yates et al., 2011). During the discussion of the tRAT, each team member may engage as a peer learner, peer teacher, or debater, exploring their understanding of the foundational knowledge. The discussions also give opportunities to students to *prove out* to their peers what they have learned from the pre-class assignments and self-directed learning processes. This practical experience reinforces learning skills and a shared belief that active learning is the best way to learn.

Measurement   *Mapping to the ToE*

Readiness assurance tests can also be mapped with the Measurement aspect of ToE. The individual iRAT and team tRAT incrementally measures individual and team pre-class readiness. These formative assessments should target what matters most as foundation for the later applications and learning outcomes. Instructors can determine which teams need additional support and intervene accordingly. With reference to ToE tip, *measurement is used early and repeatedly during the delivery process* (Hintze-Yates et al., 2011). The RATs assure real-time measurement of the quality of student learning, rather than waiting for an exam several weeks later. The tRAT requires interpretation and group decision-making to achieve success. Student performance on the RATs sets the stage for the next two steps, instructor clarification and review for select problems and concepts, followed by team applications.

Relationship   *Mapping to the ToE*

Readiness assurance tests can also be mapped with the Relationship aspect of ToE. The best tip for this mapping is *Connect authentic student desires with performance challenges* (Hintze-Yates et al., 2011). The regular performance feedback gained via iRATs allows the instructor to set up one-on-one interventions with students who repeatedly struggle with pre-class learning. During these discussions, students are free to share both personal issues as well as study-related issues. TBL instructors can ask open-ended questions which allow students to share all issues that are hindering their academic performance. The TBL instructor may only be able to address academic issues but can direct students to school resources to help address non-academic barriers. This creates a safe learning environment tailored to the whole student and maps to the ToE top of using

interactions or interventions to ask inquiry questions that provide insight about personal background, opinions, and desires.

Step 6. Clarification and Review

The instructor's clarification and review is typically 5 to 30 minutes of in-class feedback and focused instruction from the instructor right after students complete the tRAT. The areas of focus are initially guided by what learners identify as muddy points or where most teams struggled. This step helps to clarify difficult or overlooked concepts from the pre-class learning and RAT steps. As part of the clarification and review, the instructor should ask questions to students to help understand their level of knowledge and ability to explain concepts. The instructor then identifies gaps in student understanding, challenging students with follow-up questions and just-in-time explanations or focused lectures to clarify areas of misunderstanding. At the end of this step, students should be adequately prepared to solve more complex problems in the team application.

Delivery   *Mapping to the ToE*

Clarification and review can also be mapped with the Delivery aspect of ToE. Again, the explanation and lecture content are not static. The instructor evolves the content to address any gaps in student understanding and guide students to resources that they need for their application exercises. This helps to prepare students for real-world situations. The most relevant ToE tip is to *Recognize students are signaling interest when they have a question* (Hintze-Yates et al., 2011). That interest can be used to let them drive additional thinking, learning, and exploration. Also, when a student asks the instructor a question, other students can answer the question and compare rationale for their answer. This gives students opportunities to verify principles and tendencies. The instructor then primarily serves as a facilitator of learning, that is a guide on the side rather than a lecturer (Hintze-Yates et al., 2011).

Step 7. Team Appeals and Instructor Feedback

Although in-class discussion of the RAT questions is very developmental, debating points and adjusting grades on the spot is usually not. Out of class, a team may request that the instructor consider an alternative answer to the one designated as the best or keyed as correct. To receive credit, the team must either provide a better rewrite of the question if they think it was poorly worded or a rationale with references as to why their choice was better than the best answer chosen by the instructor. All team members must review and agree to write the appeal collectively, no individual appeals are permitted following a tRAT. Only a team that takes the steps to write an appeal is eligible to receive credit for a particular question.

Feedback   *Mapping to the ToE*

Team appeals and instructor feedback can be mapped to the *Feedback* aspect of ToE. Students are free and sometimes even encouraged to challenge the instructor's questions or discussion points. The ToE tips for this aspect is *Agree on performance criteria with the performer before observing and find strengths before identifying improvements* (Hintze-Yates et al., 2011). The students tend to study concepts more deeply when they appeal and the instructor gives more comprehensive and detailed feedback to an appealing team, regardless of whether the appeal is successful. Instructors value this feedback as it often shows students are more engaged and thinking critically. Successful appeals often improve course materials, seed great test questions, and improve the performance of both the instructor and future students. Great appeals can also be shared with the class to demonstrate elevation of learning and clarification of key ideas.

Transparency   *Mapping to the ToE*

Team appeals and instructor feedback can also be mapped with the *Transparency* aspect of ToE. The relevant tips for this aspect are *Stress an assessment-mindset rather than an evaluation mindset; Use assessment so that both assessors and assesses grow through the interaction;* and *Make private performance more public* (Hintze-Yates et al., 2011). Both students and teachers grow via feedback. Students must collaborate and take action to assert that the instructor's question is not perfect. Instructor's openness to challenge and giving just-in-time feedback displays personal interest in student success. Within teams, students can quicky see which students are offering regular contributions to the team's work and intervene with peers who are not contributing. Instructors can also use this information to intervene in more severe cases with students who need to improve their learning or teamwork skills.

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Phase III: Team Application Phase

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Step 8. Team Application and Active Discussion

Students, in teams, are presented with a scenario or vignette similar to problems they will be solving in their careers. They are challenged to choose the best answer which may require interpretation, calculation, application, prediction, analysis, or synthesis of given information and then make an appropriate decision or a specific choice from a range of options. They then report their decision or choice simulta-

neously with other teams and explain or defend their decision or choice to the class. This is followed by an in-class active discussion led by the faculty facilitator (typically the same instructor who prepared the pre-class materials). Through critical thinking and comparing different ideas shared by different teams, students practice elevating their problem-solving and decision-making skills. The discussions and judgements made in class help them prepare to perform in their future professional fields.

The structure of the team application follows the TBL 4-S principles, Significant problem, Same problem, Specific choice, and Simultaneous report (Michaelsen & Sweet, 2008). The *significant* problem implies that students solve problems that are realistic. Problems must authentically represent the type of problem that they are about to face in the workplace or are foundational to the next level of study. The answers should not be able to be found in any source (e.g., internet, textbook), but can only be discerned through in-depth discussion, debate, or dialogue within a team. The s*ame* problem implies that every team works on the same problem at the same time. There needs to be a s*pecific* choice for the student/team to choose. Each question of the application must be formatted as a multiple-choice or reduced to a compare-and-contrast decision from a set of specific options, such as a gallery walk. Each team must review all options and make one specific choice, then prepare a rationale for why they see that choice as the best answer and why each of the alternatives was not chosen. Finally, there is a *simultaneous* report. Teams display their specific choices for the best answer to the application, all at the same time. This way, everyone immediately sees the answers from other teams and can compare them to their own team answer. This simultaneity also avoids answer drift, where teams will avoid initially answering or change their answers after seeing answers from other teams.

Cognitive Complexity   *Mapping to the ToE*

Team applications can be mapped with the Cognitive Complexity aspect of ToE. This step fosters a healthy mix of critical thinking and discussion. Problems are not rote exercises from pre-class material but rather are designed to force students to synthesize and apply core knowledge to real-world situations. Students are usually allowed to access outside material that is not in the original class learning material. TBL instructors probe team members to identify assumptions and explain the rationale driving their answers. The resulting discussion provides a valuable learning opportunity to elevate critical thinking.

Scope of Learning   *Mapping to the ToE*

Team applications can be mapped with the Scope of Learning aspect of ToE. The value of this step is in the learning and discussion process. The team application often requires students to assess process elements and content elements across multiple modules they are learning. There is typically no single *right* answer, but students must compare the merits of many *good* answers to find the best. By exercising the learning process, students can broaden their understanding and concepts to a variety of complex real-world situations.

Social Orientation   *Mapping to the ToE*

Team applications can be mapped with the *Social Orientation* aspect of ToE. There are initially strong performers and weak performers on most teams. This disparity can solidify in some teams or resolve over time, based on efforts of each learner and the quality of the teamwork and communication between members. Moving from personal focus to a collaborative focus can elevate learning for all, evident by the tip *Team roles can help bridge the gap between individual efforts and team results* (Hintze-Yates et al., 2011). High performing teams have high cohesion and trust, discuss team performance and offer regular rich feedback, openly share and explain ideas even when there is disagreement, work to shared results, and monitor and support members who may be struggling.

Step 9. Class Discussion and Debrief

Following teams completing an application and simultaneous reporting their results, the faculty facilitator leads a class discussion allow teams to explain and explore their thinking, compare and contrast answers between teams, and elevate discussion through facilitated critical thinking questions. This phase also helps to clarify any conceptual misunderstandings, answers team questions related to the application, and offers the instructor's rationale for the *best* answer and key take-home points as closure to the discussion. The facilitator may also choose to debrief with the class at the end of the day using the PE SII assessment approach (Apple et al., 2016c) and periodically implement action plans to help improve learning across the course.

Feedback   *Mapping to the ToE*

Class discussion and debrief can be mapped with the *Feedback* aspect of ToE. During class discussion, the TBL instructor helps to facilitate the analysis of ideas from multiple teams and solicits or offers feedback on the strengths and limitations across many possible answers. End of day debrief also offers an opportunity for students and instructors to learn from what went well and improve on what could have been done better. This debrief also helps to demonstrate to students that everyone benefits from regular feedback.

Relationship   *Mapping to the ToE*

In-class debrief also can be mapped with the *Relationship* aspect of ToE. Openness to feedback in both directions enhances the connection between the students and the instructor. The debrief is an open session where a broad range of issues can be expressed. Coaching can cover both course topics as well as emotional intelligence-related topics such as group dynamics. The enhanced connection also opens the door to future one-on-one discussions where both course-related and professionalization topics can be discussed.

Phase IV: Evaluation Phase

Step 10. Self and Peer Evaluation

Periodically in TBL, students reflect on self and peer performance and offer feedback regarding their own and their peers' contributions to the team. This can be low stakes, for example a weekly team meeting or team SII or moderate stakes for example a mid-semester peer evaluation rubric with specific recommendations offered by peers to each learner for improvement. It can also be high stakes, such as the end of course peer evaluation rubric and criteria-based peer grading. All these reflection processes should be primarily designed to support self and peer growth through regular objective performance assessment, discussion, and peer support. They also help to keep students accountable to their teammates and attentive to their own performance within the team.

Students often find self and peer evaluation to be uncomfortable. For students new to TBL or peer evaluation, faculty may want to encourage students to practice self-assessment initially and later share and discuss their own self-assessment with peers, rather than jumping into evaluating others. This initial assessment process helps to build trust and team cohesion and serves as a foundation for the future difficult conversations that might be required later in the course. Team contracts can help the team agree on shared expectations and resolution strategies early in the course before conflicts arise. It is also best if there are both quantitative and qualitative components to the feedback, with faculty guidance offered to help students to share objective and constructive feedback with their peers. The final peer evaluation is typically completed anonymously and impacts each student's grade in the course. Be cognizant that this should only occur if team members are providing and responding to constructive feedback throughout the course, well before the final peer evaluation occurs.

There are other potential barriers to the peer evaluation process. Sometimes purely negative comments, degrading or meaningless feedback, or perceptions of bias can make teammates upset. Some students may overestimate or underestimate their performance and are surprised by the feedback from their peers. Sometimes all teammates get positive feedback from the team to avoid conflict or as part of collusion to avoid exposing themselves or addressing poor performance.

Strategies for effective peer evaluation include providing training students to give each other proper and constructive feedback, based on expectations developed within a team contract. Create a peer evaluation rubric with clear goals and measurable outcomes that embed the ideas and considerations gathered from students and instructors. Finally, approach reflection and peer evaluation in ways that build trust between peers and offer productive feedback for growth.

Feedback   *Mapping to the ToE*

Peer evaluation can be mapped with the *Feedback* aspect of ToE. Feedback in this step is primarily focused on students' ability to work with and contribute to the team. The feedback rubric has measurable outcomes which allow for objective feedback to be given to each student. The goal is to improve the elements of students' performance and emotional intelligence to improve their contributions to diverse groups over time.

Social Orientation   *Mapping to the ToE*

Peer evaluation can be mapped with the *Social Orientation* aspect of ToE. The tips of ToE for this aspect is *Have students assess one another's individual work. The boost of another identifying strengths as well as helping with improvement makes collaboration more attractive* (Hintze-Yates et al., 2011). Feedback is intended to identify strengths, improve individuals' performance within their team roles, and improve and boost contribution to the team through a team identity and focus on team performance. The peer evaluation step is also a medium for students to provide feedback that they may not be comfortable providing without structure. This evaluation also reinforces the value of interdependence and shared accountability above individualism.

Transparency   *Mapping to the ToE*

Peer evaluation can be mapped with the *Transparency* aspect of ToE. Both students and teachers grow via feedback. In the peer evaluation step, students take initial action to give feedback to their peers in the team, and instructors can provide additional insight to select students who need to further improve their team collaboration skills. Often students are not aware of their shortcomings related to working in groups. Exposing students to constructive group feedback helps them to be more collaborative in the future.

Step 11. Summative Assessments

As with traditional courses, students individually take all high-stakes exams and evaluations required to demonstrate individual competency, possibly through written midterm and final exams, oral presentations, or performance rubrics, with the results analyzed against the learning outcomes. Some TBL instructors offer opportunities for students to retake these tests in groups after the exams, a popular low-stakes opportunity to learn from what was missed on the individual exam.

Control   *Mapping to the ToE*

Summative assessments can be mapped with the *Control* aspect of ToE. These exams proved an assessment as to how well students are meeting course learning outcomes. Students who initially do not pass any major exam (or practice exam if those are offered) may be given feedback and encouraged to restudy and take a similar exam to demonstrate competency. ToE tip for the control aspect is *Conduct a mid-term assessment to take stock of how well your course meets goals, as set out in the syllabus, as well as learner expectations* (Hintze-Yates et al., 2011). A key goal of TBL is to ensure that students achieve the required course learning outcomes through authentic problems and rich feedback.

Measurement   *Mapping to the ToE*

Summative assessments can also be mapped with the *Measurement* aspect of ToE. Again, when combined with formative assessments such as iRATs, tRATs, and class discussions, TBL midterm and final exams provide useful feedback to both the students and the instructor. Instructors analyze assessment results to refine future instruction and exams to better achieve overall learning outcomes.

Discussion and Conclusion

PE has always focused on empowering learners by teaching students how to learn and how to facilitate their own growth and performance. The 14 cultural aspects of ToE can be adopted as a theoretical framework to guide the transformation of traditional educator practices to a set of research based best practices that contribute significantly to the development of quality collegiate learners (Nancarrow, 2007). A well-designed and well-facilitated TBL classroom has positive outcomes for student learning, academic achievement, and professional performance across a broad range of class sizes. The TBL method encourages students to be prepared before class and has students work in teams while in the classroom. Key benefits of TBL include student engagement and attendance, improved communica-

tion skills, enhanced critical-thinking abilities, quality of learning, and teacher job satisfaction (Ofstad & Brunner, 2013; Darby et al., 2023). The mapping of the 14 ToE aspects to the TBL process steps is a useful addition to the PE body of knowledge and a practical reference for TBL and PE practitioners seeking to implement and elevate learning through an integrated approach. The mapping demonstrates the comprehensive nature of TBL is well aligned to transforming the educational experience across the spectrum of ToE aspects as summarized in Table 2.

TBL and the 14 aspects of ToE have shared principles and benefits that are consistent with PE. They not only encourage learners to take initiative in their self-directed learning but also emphasize the importance of active learning strategies and making the learning processes more dynamic and interactive in an engaging learning environment. TBL and the 14 aspects of ToE promote working collaboratively in teams and across the class. This collaboration is central to the social orientation and relationship aspects of educational transformation. It fosters cognitive complexity and critical thinking, moving from simple recall of information to application, analysis, and synthesis of knowledge. Both aim to empower learners, challenging them to exceed their current capabilities and grow personally and professionally. Regular, constructive feedback and objective measurement of learning outcomes are integrated into both TBL and the transformational aspects, which help learners to continuously improve through objective, feedback-rich assessments. With the benefit of integrated shared principles, TBL and the ToE aim to create an educational environment that is student-centered, collaborative, and geared towards producing lifelong learners who are equipped with not only knowledge but also the skills and mindsets necessary for lifelong learning and adaptability in their careers. These benefits extend beyond the classroom, preparing students to be effective professionals.

This first step to integrate the frameworks of TBL and ToE offers opportunities for continued PE and TBL research, focused on measuring the acceptance, learning effect size, and change in learner behavior following these combined methods. The ToE provides an excellent guide for promoting individual and collective growth across educational settings, and TBL, a highly structured active learning pedagogy, offers a reproducible method to systematically deliver educational transformation. Well-designed TBL modules support all 14 aspects of the ToE, improving the foundations for effective student learning and performance. Both TBL and ToE promote student learning across many different educational levels, programs, and settings. TBL is an integrated learner-centered instructional methodology to elevate the engagement of both the instructor and students in learning processes. The 14 ToE aspects dovetail

with TBL and positively transform learners and educators involved in the educational process.

Practitioners of both TBL and ToE may use this mapping to improve their teaching effectiveness and learning outcomes. TBL and ToE in combination strongly promote self-directed and lifelong learning and offers learners regular, rich feedback. Applying the steps and tips provided within this article will support the effective delivery of TBL, rooted in the framework of the ToE. This work serves as the first focused exploration integrating both TBL and ToE educational frameworks. Future PE research may include pre and post surveys measuring ToE acceptance or effectiveness in a course that uses TBL, and enrichment of TBL methods by adopting PE mindsets and practices. Faculty are encouraged to learn, practice, and research these two synergistic educational approaches to further advance the transformation of education for the benefit of our learners.

Table 2 Mapping of TBL Steps to the 14 Aspects of the Transformation of Education

TBL Step	Relevant ToE Aspect Learner Transformation		*Top Tip*
Step 1. TBL Introduction to Students	**Challenge** Enabling → Empowering		*Maintain expectations for learners, even in the face of learning adversity.*
	Self-Awareness Self-Consciousness → Self-Growth		*Model the use of self-assessment. Use learning activities to build learning skills.*
Step 2. Build Teams with Member Roles	**Ownership** Directed → Self-Directed		*Assign students to heterogeneous teams when diverse skills are needed to tackle difficult learning challenges.*
	Efficacy Doubt → Conviction		*Accept authority and accountability for what happens around learners.*
Step 3. Pre-Class Readiness Assignment	**Design** Rigid → Responsive		*Integrate process and content elements around compelling contexts.*
	Control Faculty-Centered → Learner-Centered		*Where appropriate, use digital technology to engage students with course material, inside and outside of class.*
Step 4. Pre- Class Learning	**Challenge** Enabling → Empowering		*Don't do for students what they can learn to do for themselves.*
	Ownership Directed → Self-Directed		*Ask for an explicit commitment to hard work, cooperation, and quality results at the beginning of each learning experience.*
	Control Faculty-Centered → Learner-Centered		*Refrain from doing things for students that they can learn to do for themselves.*
Step 5. In- iRAT and tRAT	**Delivery** Presentation → Active Learning		*Mix it up and find opportunities for students to "prove out".*
	Measurement Subjective Determination → Objective Determination		*Measurement is a neutral activity and can be used for assessment. Limit measurement to what matters most. Increase measurement reliability through testing and refinement.*
	Relationship Emotionally Distant → Emotionally Invested		*Connect authentic student desires with performance challenges.*

Table 2 Mapping of TBL Steps to the 14 Aspects of the Transformation of Education (*continued*)

TBL Step	Relevant ToE Aspect Learner Transformation	*Top Tip*
Step 6. Clarification and Review	**Delivery** Presentation → Active Learning	*Recognize that when students have a question, they are signaling interest; use that interest to let them drive additional thinking, learning, and exploration.*
Step 7. Team Appeals and Instructor Feedback	**Feedback** Evaluation → Assessment	*Agree on performance criteria with the performer before observing and find strengths before identifying improvements.*
	Transparency Private → Public	*Stress a mindset of assessment rather than evaluation; use assessment so that both assessors and assessees grow through the interaction which also serves to make private performance more public.*
Step 8. Team Application and Active Discussion	**Cognitive Complexity** Memorizing → Problem Solving	*Critical thinking and problem solving.*
	Scope of Learning Situational Understanding → Interdisciplinary Understanding	*Regularly assess process elements as well as content elements.*
	Social Orientation Individual → Community	*The use of formal team roles can help bridge the gap between individual efforts and team results.*
Step 9. Class Discussion and Debrief	**Feedback** Evaluation → Assessment	*Pursue assessment activities that lead up to high-stakes performances.*
	Relationship Emotionally Distant → Emotionally Invested	*Avoid projecting personal fears and performance anxieties on students. Connect authentic student desires with performance challenges*
Step 10. Self and Peer Evaluation	**Feedback** Evaluation → Progress Report	*Find strengths before identifying improvements.*
	Social Orientation Individual → Community	*Have students assess one another's individual work. The boost of another identifying strengths as well as helping with improvement makes collaboration more attractive.*
	Transparency Private → Public	*Use peer assessment (where the performance of peer individuals and teams are assessed) so that both assessors and assessees grow through the interaction which also serves to make private performance more public.*
Step 11. Summative Assessments	**Control** Faculty-Centered → Learner-Centered	*Conduct a mid-term assessment to take stock of how well your course meets goals, as set out in the syllabus, as well as learner expectations.*
	Measurement Subjective Determination → Objective Determination	*Remember that measurement is a neutral activity and is used for assessment and evaluation. Increase measurement reliability through testing and refinement.*

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