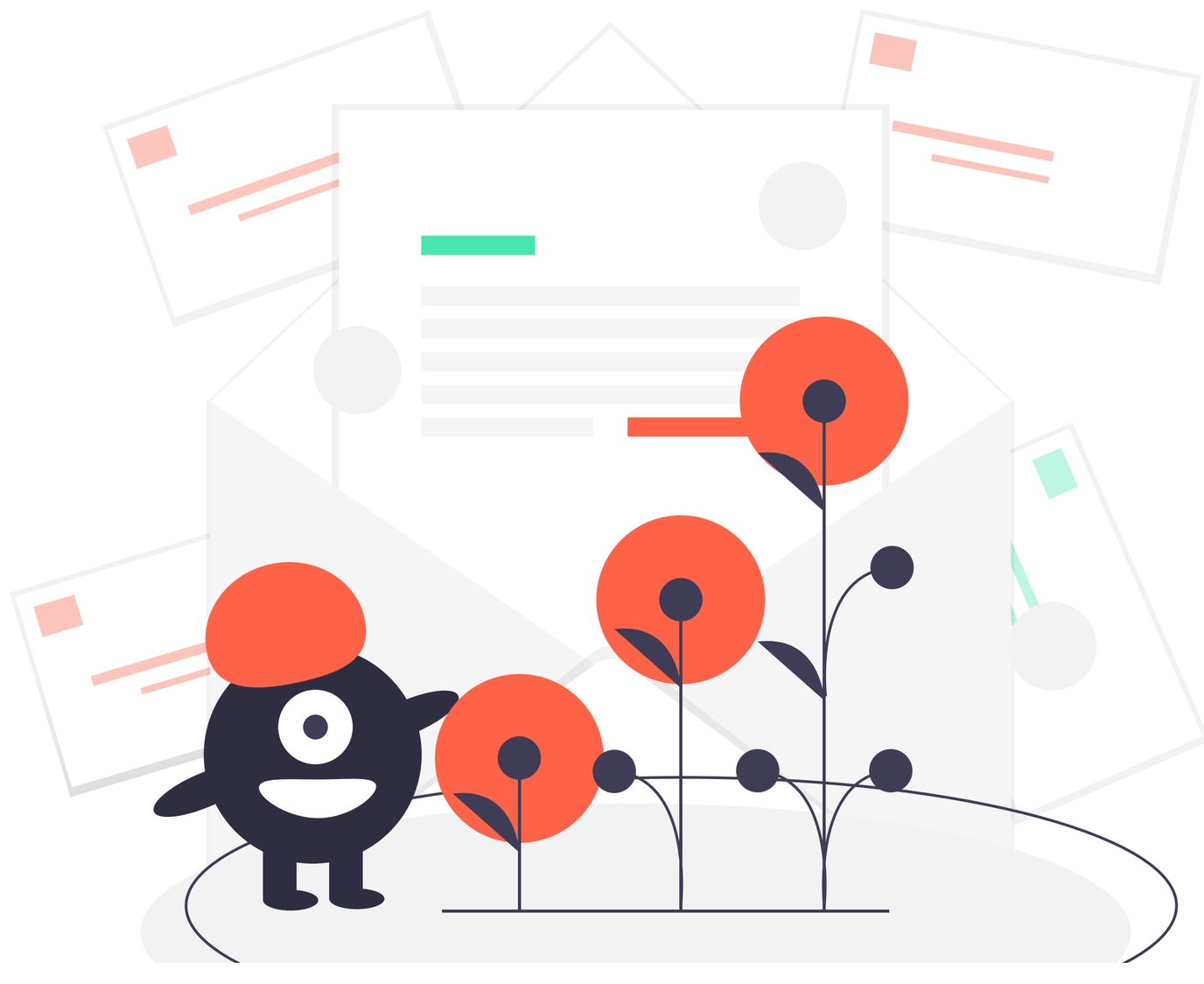
To Sharon and Lauren,

This is our printed document. We don’t include the references on the cards because it looks a little messy and is not user-friendly. We also have the website (https://egia.gitbook.io/bigideas/), which have all the cited references.

The actionable tags on each card are our “big ideas”. You can see the description of them in Tutorial part.

Each card is one actionable suggestion for learning engineers and curriculum designers. These cards are categorized by five phases and related to one or more actionable tags.

Please read the tutorial first before you dig into the cards. It will show how we help our audience to use and learn these cards.

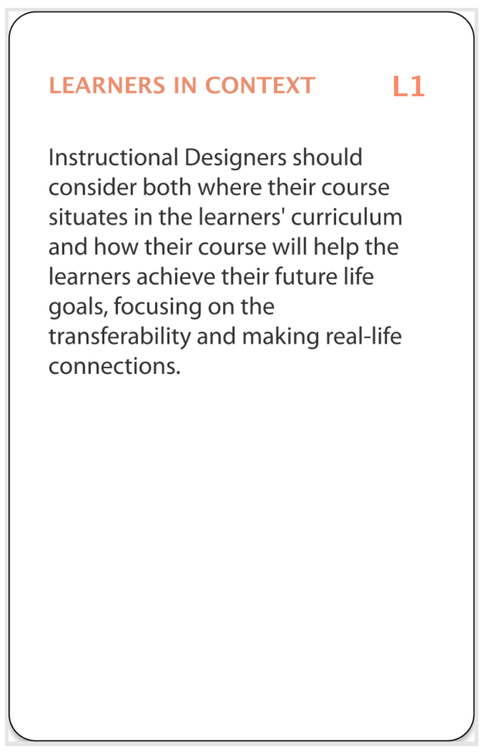


A TUTORIAL FOR CARD TOOLKIT

If you want the electronic version of this toolkit, please visit the website:
https://egia.gitbook.io/bigideas/

Hi, learning engineers and curriculum designers! This set of cards can be a toolkit to help you learn some “big ideas” in your career. You can use these suggestions to improve your work. The toolkit contains the following parts: Tutorial, Consulting Challenge, Flash Cards and Card Index. Before you start, please read Tutorial first. Then you’ll know how to use the toolkit.

On the front of each Flash Card, we summarize the content in one key sentence. We divided the whole process of design into five phases: Learners in Context, Goal, Assessment, Instruction and Evaluation. You can see which phase the card is related to in the upper left. In the lower left, you can see some actionable tags related to the card. They are big ideas that we implement throughout the design process. You can see the explanation of these tags in the next page.



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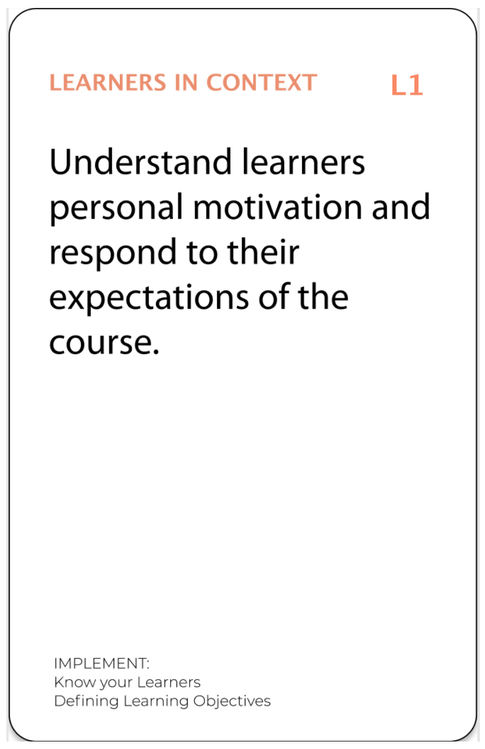
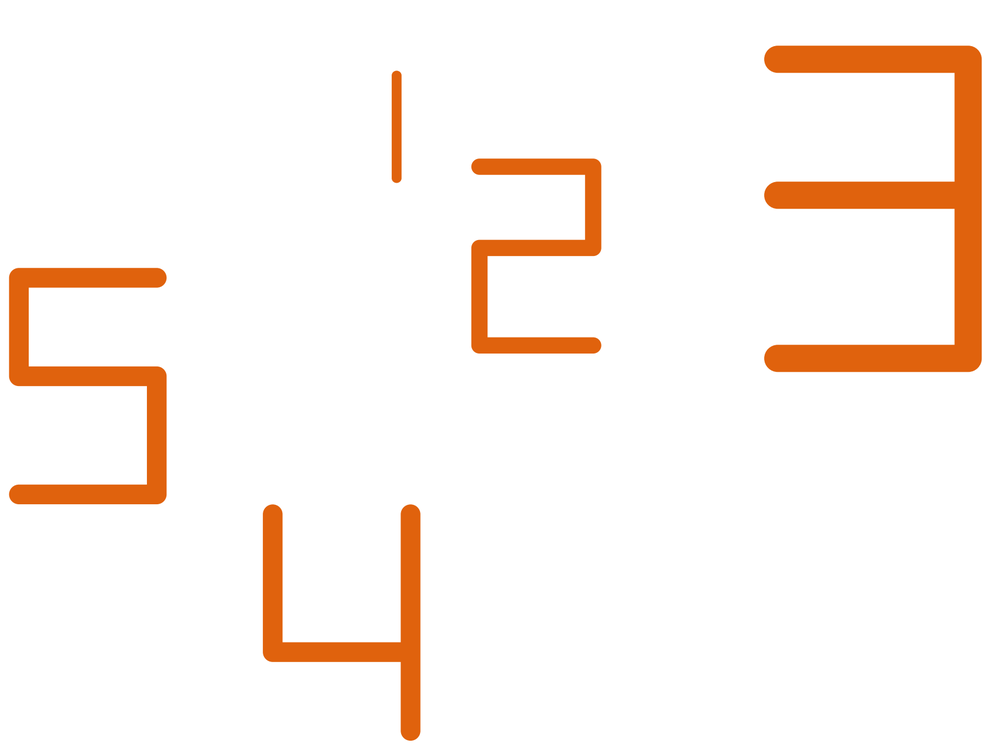


Front

On the back of each Flash Card, we elaborate it in detail to help you understand the content better. After you learnt the card, you can recall the detailed instructions on the back with the key sentence prompts on the front. In this way, you can learn better!



The following is the specific how-to:

For the first time you use the toolkit, you can read through the cards for overview. The cards are categorized by different phases in educational design, that is learner in context, goal, assessment, instruction and evaluation. And each card has an actionable tag as follows.

Know your Learners
it's about individual differences and the learner background and everything

Define Learning Objectives
it's about making the learning objectives clear to the learners what they will learn, why, how, etc.

Feedback
it's how can the feedback be utilized whether it's from students or teachers

Individual learner Progress
it's how to measure/monitor individual student learning when you have a lot of students in a course

Group Work
How to faciliate group work in the course

Using Technology in Classroom
What factors to consider before deciding on any technology in a classroom

Social and Cultural Climate
how can diversity impact your students

Knowledge Organization
how to help learners to represent and improve their mental model and cognitive process

Improving Course from Data
when you have a lot of data how to utilize it

Instructional Design
when you are creating/designing instructional activities what factors to consider

Self-Reflection
how to let students self reflect on where they were and where they want to go

Assessment Design
when you are creating/designing assessment activities what factors to consider

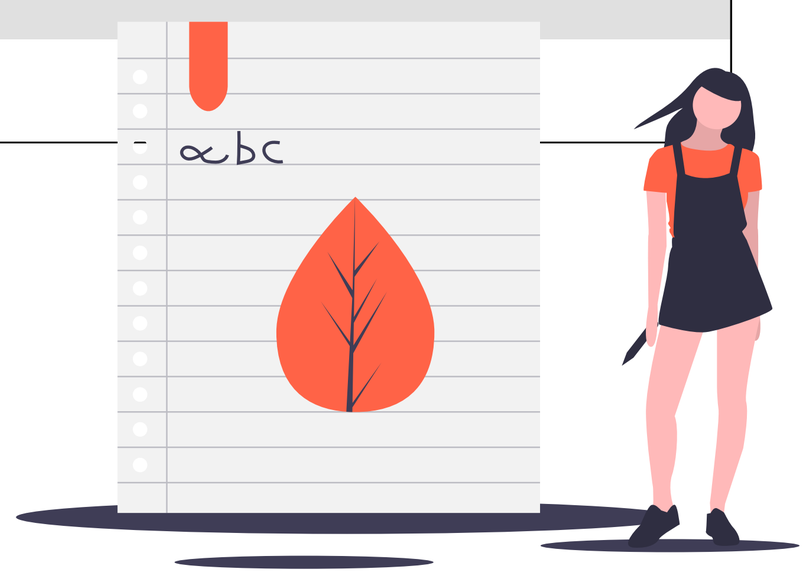
Alignment
alignment between all the phases

For the second time, you can open the educational consulting challenge and try to search for solutions in the cards and try to use these principles to contexualize the problem.

CARD INDEX

Hard to find the card you want? Use the following index table to help yourself!
You can find it according to the actionable tags and the design phases.

	Learners in Context	Goal	Instruction	Assessment	Evaluation
Know Your Learners	L1, L2, L6, L7	G3, G4, G5	I6, I9, I16	A6, A7, A8	E4, E5, E6
Define Learning Objectives	L1	G2, G5, G7, G8, G9, G10, G11	I1		
Feedback	L2, L3, L5, L8, L9		I7, I15, I17	I10	
Individual Learner Progress	L2, L3, L4, L5	G4			
Group Work	L8		A2		
Use Technology in Classroom	L7, L10		I13, I14, I15		
Social and Cultural Climate	L8, L9, L10	G6	I10, I11, I12	A11, A12	E3, E9
Knowledge Organization	L4		I3, I6	A9	
Improving Course from Data		G1	I3, I6, I17		E2, E6, E10
Instructional Design			I2, I4, I5, I8, I18, I19, I20		E1, E2, E8
Self-Reflection	L3		I18	A5	
Assessment Design				A1, A3, A4, A5, A6, A7, A8, A10	E8
Alignment		I17		A3	E2, E7



Challenge 1:

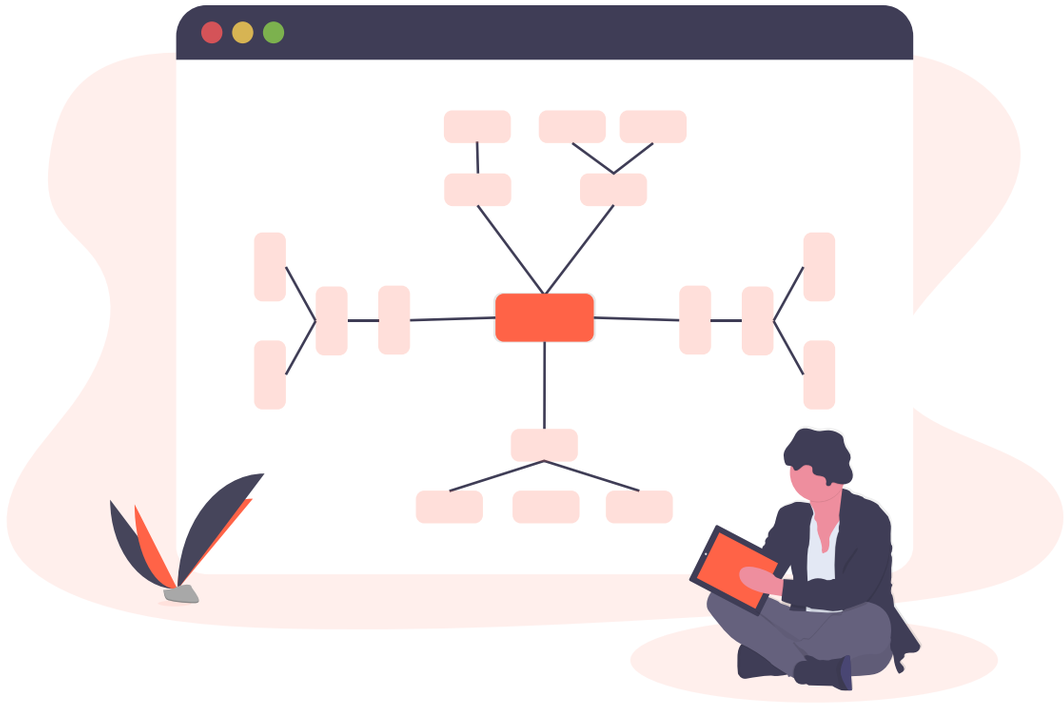
Imagine that because of your learning science background, you are asked to join a community task force charged with evaluating a publicly-funded after-school robotics course. For the first meeting of the committee, the chair asks each member to be prepared to offer a few of the most important scientifically-based principles and practical strategies for determining whether an educational course is well-designed (i.e., not yet considering implementation or impact). Please list at least four (4) recommendations. For each principle or strategy you recommend, include a one-sentence justification of why it is critical to effectively completing the task.

Recommendations for evaluating the design of the Robotics Course, with justification for each:

Challenge 2:

Imagine that you have just been hired by CMU's Eberly Center for Teaching Excellence and Educational Innovation as a Teaching Consultant. A new client arrives in your office and explains that they teach an introductory business course that typically has over 300 students. They have heard that some colleagues use online case studies that illustrate key principles, as well as online discussions moderated in real time by teaching assistants, and they think that both of these would be a great addition to their class. Please make at least four (4) recommendations for the design of online case studies and/or moderated discussions. For each strategy or principle you recommend, include a one-sentence justification for why it is critical to effective educational design.

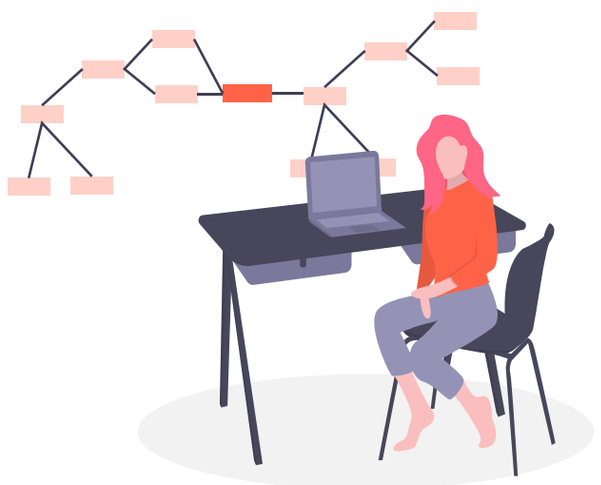
Recommendations for technological enhancement of Business 101, with justification for each:



Challenge 3:

Imagine that you have been hired as an educational designer by Elm Forest Security Solutions, a business which creates and sells complete security packages to corporations. Jonathan, a regional sales leader, tells you that he has been training new employees for a few weeks now. New hires must learn about product features and relevant marketing strategies before they can effectively meet with clients. Jonathan has been holding three-hour training sessions every week in which he talks about product features, but things are not going well: The new hires look bored, and he doesn't know if they are learning anything. A colleague recommended that Jonathan talk to you. He has never heard of an educational designer before, but he would welcome any tips or advice you have for him. Please make at least four (4) recommendations for the improvement of Jonathan's face-to-face training sessions. For each strategy or principle you recommend, include a one-sentence justification for why it is critical to effective educational design.

What recommendations do you have for Jonathan, with justification for each:



Custom Challenge:

Three challenges are not enough for you to master these ideas on the cards. In your career, you'll meet lots of challenges. As a learner, try to learn from your past experience and always look back. The best way we recommend is to make your own challenge cards. You can record the challenges you face in your career on the card and use our toolkit cards to find solutions. It's like a diary, on which you write down and reflect on your own experience, look back and practice by your own.

LEARNERS IN CONTEXT L1

Understand learners personal motivation and respond to their expectations of the course.

IMPLEMENT:
Know your Learners
Define Learning Objectives

LEARNERS IN CONTEXT L1

Instructional Designers should consider both where their course situates in the learners' curriculum and how their course will help the learners achieve their future life goals, focusing on the transferability and making real-life connections.

Understand how learners see failures.

IMPLEMENT:
Know your Learners
Individual Learner Progress
Feedback

LEARNERS IN CONTEXT L2

Learners often assume that when they can perform a task on one occasion in one context, their knowledge is secure when, in fact, it is much more difficult than that. It takes much more than one trial to learn something new, especially if the goal is for that new knowledge to be retained across time and transferred to new contexts but it is not that obvious to the learners unless told explicitly. Instructors should be especially cautious of low self-efficacy and lack of growth mindset because these can be detrimental to learners' learning and should be dealt with before using other instructional interventions.

Help learners reflect on their learning progress along the journey.

IMPLEMENT:
Individual learner Progress
Feedback
Self-Reflection

LEARNERS IN CONTEXT L3

Ask the learners to maintain a self reflection article on a website like Medium which they have to update each week with what they learned and skim through them to see where they are and where you want them to be. At the end of each class, ask learners two questions: (1) What is the big point you learned in class today? and (2) What is the main unanswered question you leave class with today? A quick scan of learner responses provides the teacher with immediate feedback on the extent of learner understanding (or lack thereof). But be careful of their feedback. Learners' perceptions are often biased.

Ask learners to represent their knowledge organization.

IMPLEMENT:
Individual learner Progress
Knowledge Organization

LEARNERS IN CONTEXT L4

Tasks that seem simple and straight-forward to instructors often involve a complex combination of skills for novices. Making learners draw a concept map of the course is a way to know, understand and contrast the different information organizations. We should consider the tasks students will be asked to perform in a given course or discipline in order to identify what knowledge organizations would best support those tasks. Novice learners have different mental representations from experts. No information organization strategy is inherently better than the other, students perform better when their organization matches the requirements of the task, and worse when it mismatches.

Tailor feedback to the learner's learning stages

IMPLEMENT:
Feedback
Individual learner Progress

For novices, the sweet spot resides between discrepancy and elaborative feedback. Learners who don't understand the use of feedback should be told to use it as a means of making adjustments. Skilled learners who are doing a familiar task may only need right/wrong feedback: they can fill in the blanks of what went wrong and how to correct it.

Misunderstanding about learning hinders learning. It is not ignorance, students have relevant knowledge and skills but they made an unsuccessful transfer.

IMPLEMENT:
Know your Learners

Among the misunderstandings student might bring to class, misunderstanding about learning might be the one that does the most harm. For instance, if students who come to class thinking that their job is to memorize facts, they will not even make the effort to try building deep understanding. Therefore, designers should address and root out the misunderstanding about learning. Students' misunderstanding is usually the result of the wrong transfer. The act of transfer requires that students have relevant prior knowledge. Therefore, designers should encourage the trials of transfer when misunderstanding is spotted

Use technology to find online resources for leaners.

IMPLEMENT:
Using Technology in classroom
Know your learners

Direct the students to online resources if there is some thing which is not readily available and you think there is not enough time to go over that topic during the normal class time. It's very important in the cases where only a few of the students don't have some required prior knowledge then those students can use technology to reach online resources and gain support knowledge.

Have learners work in teams to work on a group discussion.

IMPLEMENT:
Group Work
Feedback
Social and Cultural Climate

LEARNERS IN CONTEXT L8

Students can come from different cultures and experiences in your classroom where some of them will always take part in the discussion actively from the beginning but others will feel reluctant and afraid. By making them pair up in groups you can increase belonging and accustomed to receiving feedback.

Help students cultivate a positive identity as a member of the class

IMPLEMENT:
Social and Cultural Climate
Feedback

LEARNERS IN CONTEXT L9

The asymmetrical power in society can have an influence on students. For example, the long-held bias that women can not learn math well leads to a serious consequence where if one belongs to both the group of women and the group of math students, the bias excludes her from one group to the other. Identity the stereotypes and prejudice of the learners and use humanizing pedagogy to deal with them. Provide additional help for the minority in the class to get accostumed to the climate.

Be aware of the cultural bias in the use of techonology.

IMPLEMENT:
Using Technology in classroom
Social and Cultural Climate

For instance, technologies that support open discussion can bring openness to a relatively conservative culture, but the consequence can be positive or negative. On the other hand, technologies like video monitoring is common in some cultures but in others it can be highly invasive and might hinder students' performance. Keep in mind that African-American students, as well as individuals from other minority groups, if not kept in mind while designing learning activities can come to disidentify with formal education.

GOAL G1

When defining goals, make use of the misconceptions and misinterpretations from the past learners

IMPLEMENT:
Improving Course from Data

GOAL G1

Designers can design goals that target the gap between the actual and desired performance from the past learners. This way, the new learners taking the course won't fall into the same misconceptions and misinterpretations.

GOAL G2

Break down goals of deep understanding into actionable learners' performance.

IMPLEMENT:
Define Learning Objectives

GOAL G2

Many instructional designers use understanding as the goal of teaching. But in many authoritative goal-related theories, such as Bloom's Taxonomy, the term is considered as an unqualified goal. Because understanding is too abstract. Therefore, it is important to break down this big goal into specific visible behavioral goals. Always think about the question: What does understanding look like?

GOAL G3

Teach your learners to be self-directed and self-monitored learners besides covering domain knowledge.

IMPLEMENT:
Know your Learners

GOAL G3

Self-monitoring learning is when a student knows “how’s the learning going”. Besides the domain knowledge, instructors should also set goals to help students learn about themselves. Compared to other goals, metacognition goals are more sustained and influential. It has to be built up in the long term, even across different subjects and domains.

GOAL G4

Set up appropriate learning goals for each developmental level.

IMPLEMENT:
Know your Learners
Individual learner Progress

GOAL G4

Appropriate learning goals of learners in the different stages vary and the teacher needs to target these goals differently. For example, in the dualism stage, the learners would have frustrations in trying to understand why some questions do not have clear answers. At this stage, the goal for the teacher is trying to explain to the learners that there can be multiple answers to the same question and sometimes there might not even be an answer to a question. If the instructors set the goals that should be addressed in a later stage than the learners' current state, the learners will be confused and will have difficulty meeting those goals.

GOAL G5

Ask big questions, make promises and explain the goals to learners.

IMPLEMENT:
Define Learning Objectives
Know your Learners

GOAL G5

Rather than talking about requirements, reward and punish, instructors can talk about the promises (including big and small goals) about the course. What kind of questions will learners answer after the course? How do these questions relate to the questions learners bring to the course? What intellectual, emotional or physical abilities will the learners develop through the course? How will these abilities benefit their lives?

GOAL G6

The goal of teaching is not to make a subtraction in the student's existing cultural identity, but to do it on the basis of respecting the unique knowledge of the student

IMPLEMENT:
Social and Cultural Climate

GOAL G6

If teachers do not have their own cultural prejudice to understand the social and cultural background of the students, the prior knowledge of the macro-system embedded in each student should be respected and utilized. What the teacher should do is not to change the unique cultural knowledge of the students, but to learn the prior knowledge brought by these students, and use the knowledge to better help students understand the new knowledge.

GOAL G7

Keep in mind that the far transfer is the central goal of education

IMPLEMENT:
Define Learning Objectives

GOAL G7

The goal for the students is to achieve mastery. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned. So the goal is for the instructor to not only focus on getting the students to acquire individual component skills but also guide them on how to integrate it and to know when to apply it.

GOAL G8

Use established goals as an entry point to set up goals.

IMPLEMENT:
Define Learning Objectives

GOAL G8

Established goals can be the state content standards, district program goals, departmental objectives, and exit-level outcomes. These goals can provide the rationale for the short-term goals in each lesson. Designers can get inspiration from these goals and break them down into the curriculums. Goals typically include a range of types: conceptual, procedural, dispositional and meta-level goals.

GOAL G9

Designers should focus more on the goals which stimulate students to think by having varied interpretations and ambiguity in it.

IMPLEMENT:
Define Learning Objectives

GOAL G9

To teach students how to develop their thinking in that domain and to stretch their cognitive thinking to understand the reason that there can be multiple interpretations of something and they can be correct with having different explanations about it so instead of thinking logically that there is only one correct way of doing something focus on goals which focus on their development as a whole so they can develop their personal views about it.

GOAL G10

Make explicit the relationship among goals

IMPLEMENT:
Define Learning Objectives

GOAL G10

One of the differences between knowledge and understanding is that knowledge is the “part” while understanding is the “whole”. Therefore, goals regarding the relationship among concepts also need to be addressed. Meanwhile, the relationship among goals also ought to be captured and explicitly presented to students. Goal tree could be a good way to present the internal relationship among goals.

GOAL G11

Create and adjust the difficulty level of goals to create the feeling of flow.

IMPLEMENT:
Define Learning Objectives

GOAL G11

Students get the experience of a flow when the task is neither too hard or too easy; otherwise, if the task is too easy, students get boring, if the task is too hard, students get de-motivated. Therefore, the difficulty level of the goals should be adequate so that students can get a sense of flow when completing the core tasks. It is also desirable to adjust the difficulty level of goals throughout the course to ensure that students can still feel a sense of flow as they gain mastery toward the materials. The technique is also known as incremental difficulty.

INSTRUCTION **I1**

Provide students with exemplary projects so that they have a clearer understanding of the learning objectives.

IMPLEMENT:
Define Learning Objectives

INSTRUCTION I1

This sounds like backward instruction, which was mentioned here by a 6th-grade language arts teacher who talked about teaching writing skills. When students identify characteristics of exemplary projects, they have a "map" of units in mind so that they are more enthusiastic about the process. "Backward" can be interpreted in many perspectives.

INSTRUCTION **I2**

Use the elements of WHERETO to make the instructions engaging and effective.

IMPLEMENT:
Instructional Design

INSTRUCTION I2

The WHERETO elements include: WHERE and WHY (learning goal and purposeful work), HOOK and HOLD (linking students' interest), EXPLORE and EQUIP (experience to be equipped for performance task), RETHINK (metacognitive reflection and revision), EVALUATE (evaluate work and progress), TAILORED (personalization), and ORGANIZED (organize for optimal effectiveness).

INSTRUCTION I3

Make knowledge structure explicit to a novice.

IMPLEMENT:
Knowledge Organization

INSTRUCTION I3

Instructors are experts in their knowledge structure within their domain. They organize their domain knowledge around meaningful features and abstract principles. In contrast, most of the learners have not yet developed meaningful ways of organizing the information they encounter in the courses. Since knowledge structure is abstract, it can be difficult for experts to recognize how they organize their knowledge, and thus difficult for them to communicate this organization to learners. One way to make their knowledge organization apparent to themselves and the learners is to create your concept map.

Break down the whole-task into specific steps or aspects for students doing deliberate practice.

INSTRUCTION I4

In terms of teaching, especially in teaching procedural goals, educators should teach each step at a time and adopt an appropriate method to do deliberate practice. After students master the breakdown of knowledge, the synthesis would be an ideal option to help them use the combined knowledge or strategically choose the suitable components.

INSTRUCTION I5

Use analogies to organize information in teaching

IMPLEMENT:
Instructional Design

INSTRUCTION I5

People seek common patterns to make new connections, to learn something new. Therefore, designers can use analogies to encourage integration. Analogy is a good way for students to relate their new knowledge with their original mental model. Finding a metaphor that is beneficial for learning requires the metaphor to have the above-mentioned relationship with the content to be mastered.

INSTRUCTION I6

Provide examples for appropriate ways to perform certain tasks.

IMPLEMENT:
Know your Learners
Knowledge Organization

For instance, a college freshman might misuse the strategies in high school writing class to write an argumentative essay in a college classroom. Therefore, designers can provide students with an advanced knowledge framework to encourage information organization. An advanced knowledge framework is an information organization experts use to approach a certain topic. Research indicates that students perform better when they are given an advance cognitive guideline to help to memorize a list of items.

INSTRUCTION **I7**

When giving feedback, focus on essential parts to avoid overwhelming.

IMPLEMENT:
Feedback

INSTRUCTION I7

If students receive a significant amount of feedback for their assignment, they are most likely to be overwhelmed and cherry-pick the easiest ones to fix. In other words, they might not be learning. Therefore, designers should give feedback that focuses on the essential parts. This way, students can practice more deliberately based on the feedback.

When designing the curriculum, the results of prior-knowledge assessments (pretest) could be used as a tool for student support in addressing areas of deficiency.

Many advanced courses require students to master what they learned before. Although students said they learn all the knowledge, to develop mastery, “Students must acquire component skills, practice integrating them, and know when to apply what they have learned.” Instructors always ignore these steps and make wrong assumption that students master the knowledge as long as they learn the knowledge before. It is important for instructors to see the insufficiency of their prior knowledge and work on it.

Give learners control over their learning.

IMPLEMENT:
Know your Learners

INSTRUCTION I9

There are several ways to help learners approaching the learning goal, one of them is to give much control over their education as possible. The individual project is a good way to let learners explore their interested area using skills learned in class and connect their personal goals to the goals of the course. Teachers should display their intrinsic motivation in the area to stimulate learners to find their interests and faith to dig deeper into their work.

INSTRUCTION **I10**

Education is not only about techniques, but it's also more about Humanizing Pedagogy.

IMPLEMENT:
Social and Cultural Climate

INSTRUCTION I10

Most of the time, teaching methods have different effects in different environments and groups because of the differences between learners and the environment itself. Before thinking about what teaching methods should be applied, teachers should learn and understand the cultural and social factors that may affect the growth of students that are not related to the knowledge to be taught.

INSTRUCTION **I11**

Create a natural critical environment in which the students can safely try, fail, receive feedback and try again with authentic problems.

IMPLEMENT:
Social and Cultural Climate

INSTRUCTION I11

We need to provide an environment to do the challenge and permission for students to tackle authentic and intriguing questions and tasks, to make decisions, to defend their choices, to come up short, to get feedback on their efforts, and to try again. Those tasks have a real-world context and may arouse intrinsic interest. By learning in a natural critical learning environment, students can practice the skills and knowledge they learned in class in their preferred way and polish their work by critical thinking.

INSTRUCTION I12

Set norms together before learning.

IMPLEMENT:
Social and Cultural Climate

INSTRUCTION I12

Norm is a specific expression of culture. Students of different cultural backgrounds bring the norms belonging to their groups into the classroom. When minority norms differ from teachers and mainstream students in the classroom, they may misunderstand interactions and lose a sense of belonging, which ultimately leads to learning disabilities. Building a common norm that belongs to all learners will help reduce misunderstandings and conflicts and improve the sense of belonging.

INSTRUCTION I13

Use technology to shift the way of teacher-learner interaction and learner-learner instruction to two-way communication.

IMPLEMENT:
Using Technology in classroom

INSTRUCTION I13

Rather than the teacher talking and learners listening passively, more collaborative work and communication will happen during, before and after class. For instance, Google Docs will help learners do group projects asynchronously and synchronously; the discussion board will help learners swap their thoughts towards one topic; the Facebook group will help learners form groups to do discussion more conveniently. In addition, designers can increase engagement by allowing learners to communicate about course content and their learning experiences.

INSTRUCTION **I14**

Prepare learners who are not familiar with the technology by additional instruction.

IMPLEMENT:
Using Technology in classroom

INSTRUCTION I14

New technology sometimes will take additional learning efforts for students who do not familiar with the technology before. Designers should apply the teaching platform that is easy to learn, accord with user habits. If necessary, designers should adopt some basic tool instructions before the course formally starts.

INSTRUCTION I15

Use technology to provide timely and targeted feedback.

IMPLEMENT:
Using Technology in classroom
Feedback

INSTRUCTION I15

Technology can be used as a tool to assess formatively students' understanding and give timely and targeted feedback to both students and the teacher. Research has shown that when students are working on a problem, knowing what went wrong and what is right can enhance their learning. It is easier to incoporate the feedback and amend their knowledge structure immediately after they realized something went wrong. Meanwhile, untimely feedback can be a problem for educator as it is less actionable for students to incorporate.

INSTRUCTION **I16**

Help students cultivate growth mindset when giving feedback.

IMPLEMENT:
Know your Learners

INSTRUCTION I16

Growth-oriented means learners focus on their own growth. When the learners have a growth mindset, they will be more willing to try out different learning strategies and treat each failed attempt as an opportunity for learning; Building a growth mindset improves learners' self-efficacy makes them more willing to fit in the learning community and try to adopt the growth mindset. To improve learners' growth mindset, you can give feedback based on their performance instead of some fixed personal characteristics. For example, it's better to say "You did a good job!" instead of "You are smart!"

INSTRUCTION I17

Refine your design of the curriculum and iterate over time.

IMPLEMENT:
Improving Course from Data Feedback
Alignment

INSTRUCTION I17

Instructors should come back to visit the instructional design for refinement. The instructional design should be an iterative process. Designers can make improvements based on other design processes. For example, after the assessment, you can get the common misconceptions of the learners and make it as a new goal for your curriculum. After the evaluation, you may know some teaching methods may not be effective and redesign them. When you do iteration, remember to keep the alignment with goals, assessments and instructions.

INSTRUCTION **I18**

Create silence to give learners chances to talk and reflect.

IMPLEMENT:
Instructional Design
Self-Reflection

"Teaching is not more about what the teacher does than what the teacher gets the learners to do (Kloss, 1994)". When asked a question in class, wait a few seconds for students to think, reflect and respond. Create silence to help learners show us more of their thinking, help them think deeper by themselves.

Use context varied case studies instead of a similar one for the key principles.

If for each principle there will be more than one study with varying contexts applying the same principles the learners will get a better understanding and sense-making of the principles as their knowledge will be probed when they see a different condition each time based on same principles than if they were given similar case studies where there is not much stimulus.

Space out the same content over time instead of cram it into one session.

For learning over the long term, it is much better to study information repeatedly over time. Designers can design the curriculum to help learners start studying early, and touch on each topic during each study sesssion. You can also help the students to make a study plan with the spacing strategy. It can help them to memory for a long term and achieve better learning result in the summative assessment.

ASSESSMENT **A1**

Consider a wide range of assessment methods to collect different kinds of evidence of learners' learning.

IMPLEMENT:
Assessment Design

ASSESSMENT A1

Instructors should use this wide range of assessment methods to get a more complete assessment of the learners' improvement.

ASSESSMENT A2

Assess students individually and in group

IMPLEMENT:
Group Work

ASSESSMENT A2

Assign work to learners individually and in the group, so that there are interdependence and accountability. Give learners some combination of their own grade and the group's grade. They get to work in small groups to answer the same questions. The individuals can then retake the test alone, and their grade is a combination of the first and second tests. This creates a natural need for interdependence because the learners want to know what each is thinking, and it maintains individual accountability because the test scores are the individual's alone.

ASSESSMENT A3

Use GRASPS to help frame the performance tasks and align them with goals.

IMPLEMENT:
Assessment Design
Alignment

ASSESSMENT A3

GRASPS is a framework to help you design assessments using Goal, Role, Audience, Situation, Product, and Standards, in which goals and standards specifically prompt about contents related to goals as in what objectives learners need to achieve and how well they should do. The GRASPS method is considered effective by teachers as it provides performance targets and real-world mearningfulness to learners.

ASSESSMENT A4

Use criteria and rubric to assess understanding over time.

IMPLEMENT:
Assessment Design

ASSESSMENT A4

The instructor often gives grades to each piece of work without making clear the criteria and the appropriate weighting of each criterion, and they typically average those grades over the course of time to come up with a final grade. This latter practice especially makes little sense when assessing against understanding goals and rubrics over time: Averaging a learner's initial versus the final level of comprehension of a complex idea will not provide an accurate representation of their understanding.

ASSESSMENT A5

Design detailed criteria and rubric to break down the assessment and help learners know the expectations.

IMPLEMENT:
Assessment Design
Self-Reflection

ASSESSMENT A5

Convert the detailed expectations of learners' performance based on your assessment design to an analytical criteria. It divides a product or performance into distinct traits or dimensions and judges each separately. A rubric for understanding must provide concrete answers to our key assessment questions: What does understanding look like? Designers should evaluate the validity (Can your criteria really reflects on students' achievement of the goals?) and reliability (Are you confident the single result of your assessment reflects a pattern?). Then Iterate them based on students' performance.

ASSESSMENT A6

Focus assessment on long-term progress toward goals.

IMPLEMENT:
Assessment Design
Know your Learners

learners' learning is a process in which not one achievement is met but several (Wiggins, Wiggins & McTighe, 2008, p.82). In this process, instructors need to assess the learners' understanding and improvement over time and different learning goals would require a different set of assessment methods. If teachers only assess learners by one-time performance, learners do not have time to study by their own mistakes; which is an important pathway to learning. Furthermore, learners may try to avoid mistakes or feel good of their unintentional success, which means they have little motivation to learn. In Bain's (2011) book, the best teachers 'avoided grading on the curve, and instead gave everyone the opportunity to achieve the highest standard and grades. If learners have trouble improving by themselves, it is important to give them alternatives to the behaviors that resulted in poor performance.

ASSESSMENT A7

Do observation and informal interviews to assess understanding.

IMPLEMENT:
Assessment Design
Know your Learners

ASSESSMENT A7

In both formal and informal contexts, we can collect data by observing learners' behavior and interviewing them afterwards. For instance, you can observe how learners interact with the exhibits in the musuem to understand their interests, motivatinos, how they deal with failures, how they cooperate with each other etc. A follow-up interview can be conducted to further understand the conceptual and procedural learning. Sample interview questions can be: what conclusion did you reach, what would you do to further your investigation, why did you do this etc.

ASSESSMENT A8

Use open-ended questions to assess understanding.

IMPLEMENT:
Assessment Design
Know your Learners

ASSESSMENT A8

Learners are more likely to show their process of approaching the question in open-ended questions. If misunderstandings are in play, this is a better way to detect them in conversations. This is because as we frame understanding as deep we must also design assessments that can uncover the values of understanding. In open-ended questions, you can see how learners make their arguments, make connections between knowledge. In other words, open-ended questions provide educational designers a deeper and richer materials to analyze "in-depth" understanding as opposed to superficial ones.

ASSESSMENT A9

Use concept map and think-aloud to uncover learners' thinking processes.

IMPLEMENT:
Knowledge Organization

ASSESSMENT A9

These two methods provide a window for making learning visible so that the instructor can better infer learners' learning. In a concept map, it can be revealed what key concepts, relationships, and elaboration are missing in the person's current organization structure. In the short time, concept maps help quickly diagnose key misunderstanding. To look at this strategy in a longer time frame, it can also be used to assess learners' learning progress. Meanwhile, using think-alouds, we can see to what extent learners are using their own words and generate new connections instead of simply repeating and restating the text.

ASSESSMENT A10

Use assessments to help learners gain self-efficacy and a growth mindset.

IMPLEMENT:
Feedback
Assessment Design

ASSESSMENT A10

Instructors and instructional designers can design assessments from simple and straight-forward to complex and difficult so that learners can gradually gain self-efficacy by conquering the increasingly difficult questions and start to appreciate their own effort in trying out the difficult questions in the assessments. In this process, instructors should give timely feedback that focuses on the effort and growth of the learners.

ASSESSMENT A11

Design growth-oriented assessment instead of mastery-oriented to measure learning gains.

IMPLEMENT:
Social and Cultural Climate

ASSESSMENT A11

Social-subordinated learners are more likely to attribute their failures, mostly in summative assessments, to ability or internal issues when instructors possess the social stereotypes that they are just not good at that. When learners stop believing they can achieve the goals they will be in severe lack of motivation and a sense of belonging, which will drastically hinder learning. In turn, instructors should guide these learners to attribute their failures to more controllable and temporary issues like inadequate preparation, lack of relevant information, etc.

ASSESSMENT A12

Take into account the social interactions and the time that learners spend outside of classes.

IMPLEMENT:
Social and Cultural Climate

ASSESSMENT A12

Only part of the prior knowledge comes from formal learning, the daily engagement and conversation in the community are also sources constructing learner's understanding. Instructors should also pay attention to what happens to learners outside of the classes.

EVALUATION E1

Do peer-review of the backward design process with other designers to help evaluate and improve the instructional designs.

IMPLEMENT:
Instructional Design

EVALUATION E1

Peer reviews can help designers think and re-think about the instructional design of others and themselves. The designers need to record carefully and in detail about their design process and the data they collected for peer review. We can find two kinds of peers to do review. One is experts in your domain. They can share their successful experience with us and provide their deep understanding of the discipline. The other is novice in your domain. They can help you to understand your blind spot and give more insights about the difficulties of learners.

EVALUATION E2

Collect data by multiple means from learners, teachers and learning environment to evaluate instructional design for deep learning.

IMPLEMENT:
Instructional Design
Alignment
Improving Course from Data

EVALUATION E2

Design-based research needs systematic assessment to collect data. We need to combine inductive qualitative approaches with quantitative and quasi-experimental approaches, such as think aloud, systematic observation, earners' work products, eliciting responses from learners, noting how learners respond to assistance during instruction and using questionnaires or interviews. To choose an appropriate method, we need to align the choice of assessment with the specific goal of deep understanding.

EVALUATION E3

Consider the influence of cultural and social factors on teaching when doing research.

IMPLEMENT:
Social and Cultural Climate

EVALUATION E3

When a teaching method has no effect, it may not be a problem with the method itself, but the teacher does not consider the impact of the macro-system on the learner when applying the method. So when we are evaluating or researching our teaching methods, we should also consider the cultural and social differences between the learner groups, and how these factors interact with the teaching methods to adjust the implementation of teaching methods.

EVALUATION E4

Do long-term observation to investigate the changes of motivation and the influential factors.

IMPLEMENT:
Know your Learners

EVALUATION E4

Motivation is complex. It involves in learners' attention, emotion, value, confidence, etc. Most of them can't be observed easily. When we do research about learners' motivation, we can observe learners' emotional changes and brain activities based on new technologies. Besides, the state of motivation may be ups and downs in a short period of time, so it is very important to understand the changes in learner motivation and to speculate on its complex influencing factors. Finally, focus on the interactions of factors that influence motivation. These factors are interrelated and affect motivation together.

EVALUATION E5

Compare novice and expert in research to help understand how learners can improve mastery level.

IMPLEMENT:
Know your Learners

EVALUATION E5

We can compare novice and expert to see the difference on cognitive mechanisms and how a novice can become an expert. For example, a research about how novice and expert solve two physics problems shows the difference of knowledge reorganization between them. Such comparative researches can help us understand the paths and mechanisms of how learners become experts and provide insights for deliberate practice.

EVALUATION E6

Collect long-term and interdisciplinary data on learners' metacognitive.

IMPLEMENT:
Know your Learners
Improving Course from Data

EVALUATION E6

Metacognitive changes may happen after a long-time intervention. It can also affect learning in multiple subjects at the same time. For example, learners can use the metacognitive skills they have learned in physics classes to achieve chemistry learning progress. And chemistry learning will provide more practice opportunities for metacognitive skills. If we want to study the impact of teaching on learners' metacognition, we need to study the application of metacognitive skills in multiple subjects and the interaction of these subjects.

EVALUATION E7

Plan evaluation ahead of teaching.

IMPLEMENT:
Alignment

EVALUATION E7

Instructional Designers need to think ahead about how to design a course to help get valuable research data. For example, when a designer does not know which teaching method is more effective in a certain situation, he can design a contrast experiment in advance in the classroom and use different methods to teach the same content in two classes. When aligning with goals and evaluations, the needs of the research will also influence the instruction. Designers should think about research design in advance in the design process.

EVALUATION E8

"No one fits all". Consider the application condition of the teaching methods in the research.

IMPLEMENT:
Instructional Design
Assessment Design

EVALUATION E8

As for teaching method, "no one fits all". In the process of teaching evaluation and research, we should study various teaching methods and pay attention to their effective and ineffective conditions. For example, multimedia principle may fail on some second-language learners because they are unfamiliar with the language and needs more text to understand the content. When designing research, think about the application conditions of the teaching method based on learning principles and learners in context, make assumptions and design the control and treatment.

EVALUATION E9

Do instructional research in the authentic environment.

IMPLEMENT:
Social and Cultural Climate

EVALUATION E9

Experiments can help us to find the internal connection between instruction methods and learning outcomes. But the problem is that it ignores the authentic complex environments, where different factors can interplay and co-influence learning. Research in authentic environement first can help us understand how the various factors in the real world work together, and then understand the elemental levels to ensure that the research can ultimately serve the real-world instructional design (Nathan & Alibali, 2010).

EVALUATION E10

Find a focus first to set up the goal of the research.

IMPLEMENT:
Improving Course from Data

Research design first needs to identify a goal, which is the question we need to answer. The focus of the research may be on the key issues that have been missed in the academic achievements. It can also be derived from the practical experience of the teachers (for example, some researchers can ask teachers what teaching method they think is effective) (Carver, 2006, p.214).