Learning Strategies That Promote Teamwork

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Ann Arbor, Michigan
No Engineer Can Serve Two Masters – Or Can He?

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Director of Engineering Technology Area
Corporate Engineering Department
Monsanto Company
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Industry-University Interactions

October 15, 1976
DR. M. R. LOHMANN
Dean, Division of Engineering,
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Oklahoma State University
Stillwater, Oklahoma
Looking Forward – Looking Back, An Old and New
Problem of the Profession

December 2, 1977
DR. FRANK M. TILLER
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of Chemical Engineering
University of Houston
Houston, Texas
Complexity and Confusion in World Affairs. Challenge to Engineers and Educators

November 30, 1978
DR. D. L. KATZ
Professor Emeritus
University of Michigan
Ann Arbor, Michigan
Practice What You Teach

November 20, 1979
DR. JAMES WEI
Head, Department of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts
Rejuvenation of Chemical Engineering

November 14, 1980
DR. MAX S. PETERS
Professor of Chemical Engineering
Dean Emeritus, College of Engineering and
Applied Science
University of Colorado
Boulder, Colorado
Politicians and Higher Education in a Technical Society

November 6, 1981
DR. ROBERT L. PIGFORD
Professor of Chemical Engineering
University of Delaware
Newark, Delaware
Merging Theory and Practice in Chemical Engineering Education

December 10, 1982
DR. R. BYRON BIRD
Chemical Engineering Department
University of Wisconsin
Madison, Wisconsin
Book-Writing and Chemical Engineering Education: Rites, Rewards and Responsibilities

April 6, 1984
DR. ROBERT C. REID
Department of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts
The Graduate Experience

April 12, 1985
DR. NEAL R. AMUNDSON
Department of Chemical Engineering
University of Houston
Houston, Texas
Reminiscences, Random Comments, and Landmarks

April 18, 1986
DR. JOHN M. PRAUSNITZ
Department of Chemical Engineering
University of California
Berkeley, California
Versatility and the Integration of Experience

April 17, 1987
DR. JOE M. SMITH
Department of Chemical Engineering
University of California
Davis, California
Chemical Engineering Education for Foreign Students – Blessing or Burden

April 8, 1988
DR. HENDRICK C. VAN NESS
Department of Chemical Engineering
Rensselaer Polytechnic Institute
Troy, New York
Chemical Engineering Education – Will We Ever Get It Right?

April 11, 1989
DR. ROBERT N. MADDOX
School of Chemical Engineering
Oklahoma State University
Stillwater, Oklahoma
Chemical Engineering Design: Plant, Project, Process, Phreshman

April 27, 1990
DR. STUART W. CHURCHILL
Department of Chemical Engineering
University of Pennsylvania
Philadelphia, Pennsylvania
Perspectives and Counterparts in Chemical Engineering Education

April 26, 1991
DR. RUTHERFORD ARIS
Department of Chemical Engineering and Materials Science
University of Minnesota
Minneapolis St. Paul, Minnesota
Chemical Engineering and the Liberal Arts Today

May 1, 1992
DR. RICHARD M. FELDER
Department of Chemical Engineering
North Carolina State University
Raleigh, North Carolina
The Myth of the Superhuman Professor

March 25, 1993
DR. STANLEY I. SANDLER
Director, Center for Molecular and
Engineering Thermodynamics
Department of Chemical Engineering
University of Delaware
Newark, Delaware
Technological and Societal Change and
Chemical Engineering Education

April 22, 1994
DR. KLAUS D. TIMMERHAUS
Department of Chemical Engineering
University of Colorado
Boulder, Colorado
Education and Science - Do We Really Care Enough?

April 18, 1995
DR. GEOFFREY F. HEWITT
Imperial College of Science, Technology & Medicine
London, United Kingdom
People Processing - The Chemical Engineering Way

April 12, 1996
DR. BRUCE A. FINLAYSON
Rehnberg Professor and Chair,
Department of Chemical Engineering
University of Washington
Seattle, Washington
Can Professors Use Technology to Teach
Faster, Better, Cheaper?

April 25, 1997
DR. H. SCOTT FOGLER
Vennema Professor, Department of
Chemical Engineering
The University of Michigan
Ann Arbor, Michigan
Teaching Critical Thinking, Creative Thinking, and
Problem Solving in the Digital Age

February 20, 1998
DR. PHILLIP C. WANKAT
School of Chemical Engineering
Purdue University
Lafayette, Indiana
Educating Engineering Professors in Education

February 26, 1999
DR. THOMAS F. EDGAR
Associate VP for Academic Computing and
Instructional Technology Services
The University of Texas at Austin
Austin, Texas
Process Engineering in the 21st Century:
The Impact of Information Technology

February 25, 2000
DR. G. V. "REX" REKLAITIS
Professor and Head, School of Chemical Engineering
Purdue University
West Lafayette, Indiana
Preparation of Chemical Engineers
for Manufacturing Leadership in the 21st Century

February 15, 2001
DR. RONALD W. ROUSSEAU
Professor and Chair, School of Chemical Engineering
Georgia institute of Technology
Atlanta, Georgia
Striking a Balance in Teaching Today's Students
to Solve Tomorrow's Problems

March 1, 2002
DR. EDWARD L. CUSSLER
Chemical Engineering and Materials Science
University of Minnesota
Minneapolis, Minnesota
What Happens to Chemical Engineering Education?

April 25, 2003
DR. ARVIND VARMA
Department of Chemical and
Biomolecular Engineering
University of Notre Dame
Notre Dame, Indiana
Future Directions in Chemical Engineering Education:
A New Path to Glory

November 5, 2004
DR. MARK E. DAVIS
Warren and Katharine Schlinger
Professor of Chemical Engineering and
Executive Officer of Chemical Engineering
California Institute of Technology
Pasadena, California
Adapting Chemical Engineering Education
to Increasing Job Diversity

November 10, 2005
DR. TIMOTHY J. ANDERSON
Professor of Chemical Engineering and
Associate Dean for Research
University of Florida
Gainesville, Florida
Investing in Faculty: Rationale and Approach
to Faculty Career Development

February 8, 2007
DR. ROBERT C. ARMSTRONG
Chevron Professor and Department Head
of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts
Frontiers in Chemical Engineering Education

October 25, 2007
DR. JOHN P. O'CONNELL
Harry Douglas Forsyth Professor
of Chemical Engineering
University of Virginia
Charlottesville, Virginia
Fundamentals: Wellspring for Adapting to Change

October 24, 2008
DR. DIANNE DORLAND
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Learning Strategies that Promote Teamwork

LEARNING STRATEGIES THAT PROMOTE TEAMWORK

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Introduction

Over the last few years, we have all been assailed by challenges to engineering education. We are told that we are doing it wrong. We are told that we must create the engineer of the future, yet the standards for this product are frequently more descriptive than measurable. My thoughts on addressing some of these challenges through team formation and development in engineering education is something I would like to share with you.

At Rowan University we promote teamwork throughout the engineering curriculum. Our hallmark is the Engineering Clinics sequence, a model that provides real world experiences for engineering students over their four-year journey. Through the Clinics we promote concepts that help develop personal learning strategies. By assisting students with learning strategies that support teaming concepts, we seek to strengthen the dynamics of team development and their educational success. In this presentation, I describe tools that we use to promote intentional learning in our students. Then I segue to tips on teaching and intentional learning from the professor's point of view. Finally, I emphasize that we need to understand how to integrate our unique learning capabilities into a team structure.

Casey Stengel said, “Finding good players is easy; getting them to play as a team is another story.” In engineering colleges across the nation, we get great students, but getting them to form productive teams and work together on projects often presents challenges.

Rowan Curriculum

Rowan University has developed a unique curriculum for engineering education. The University started as a Normal School in 1923. Over time it became Glassboro State Teachers College and then received a life-changing legacy of $100 million in 1992 that enabled the creation of the College of Engineering. A proviso of this legacy was that the college would emphasize a hands-on engineering experience in the curriculum, which is delivered primarily through Engineering Clinics and secondarily through experiential-focused coursework. The College has 500 undergraduate students and 32 full-time faculty members in four majors. Students are distributed approximately equally among the engineering majors, chemical, civil and environmental, electrical and computer, and mechanical engineering.

Rowan has an intensive, eight-semester, Engineering Clinic sequence (See Chart I). In the first two years, the focus is on guided engineering experiences. The first Freshman semester deals primarily with engineering measurements, and the second semester with reverse engineering of a product or process. Previous hands-on, multidisciplinary projects have involved products and processes such as automatic coffee makers, fluidized bed coating, the brewing process, and the engineering systems within the human body. In addition, freshman seminar skills and adaptation to college life encompass time management, resume building, and interactive personal skills. At this level the students also engage in interpretation and application of a learning patterns survey, the Learning Connection Inventory (LCI). The LCI is used to assist students in creating strategies for successful learning and teamwork.

Chart I
The Rowan Engineering Clinic Sequence

Year	Term	Semester Credit Hours	Contact Hours	Detail
Freshman	Fall	2	3	One, 1-hr lec One, 3-hr lab
	Spring	2	3	One, 1-hr lec One, 3-hr lab
Sophomore	Fall	4	9	Three, 1-hr Writing class One, 3-hr Engr lab
	Spring	4	9	Three, 1-hr Speech class One, 3-hr Engr lab
Junior	Fall	2	6	Two, 3-hr labs
	Spring	2	6	Two, 3-hr labs
Senior	Fall	2	6	Two, 3-hr labs
	Spring	2	6	Two, 3-hr labs

In the Sophomore year, the Clinics emphasize technical communications skills and the application of design. Students are organized into "corporations" that design and build products using advanced engineering tools, and they develop speaking and writing skills through embedded assignments. Past projects have included microbial fuel cell design, crane and bridge design, sustainable energy and materials optimization, and rocket launcher designs. Communication faculty members teach within the Sophomore Clinic, utilizing students' engineering projects, which are taught by Engineering faculty. This is a powerful and discipline-specific method for teaching writing and public speaking. In these first two years, disciplines may be mixed so that on any team, students from any of the College's four disciplines may be working together.

In the Junior and Senior years, students may be together on the Engineering Clinics, and there may also be graduate students on the team. There may also be students from other disciplines such as business, physics, biology,

or chemistry – the composition of the team depends on the project goals and deliverables, and is determined in conjunction with the entity that wants the product. For example, in a project with a Chilean company to increase the pigment concentration in the algae that serve as food for Salmon in order to enhance their flesh color, we had chemical and mechanical engineering students working along with students from biology. If a specialty chemicals company wants to improve a process for removing heavy metals from a waste stream, there are primarily chemical engineers working on it. The team composition is guided by the customer's goals and the skills required to complete the project.

The Engineering Clinic sequence is an incredible experience for students, with four years of design experience embedded throughout the undergraduate curriculum. The Engineering Clinics are a Rowan Engineering hallmark and we're very proud of them. Forming teams and having them complete projects successfully is very important for the Rowan Engineering Clinics, so we are invested in understanding how to make our teams function better. One of the unique aspects of Rowan's engineering program that supports the Engineering Clinics is the use of the Learning Connections Inventory (LCI). The LCI provides our students with a path to understand themselves as learners. More importantly, students can utilize this understanding of their LCI to develop strategies for improving team dynamics and their educational success.

Learning Connections Inventory

The LCI is not a test; it is a self-produced inventory that measures learning patterns. The inventory was developed by Dr. Christine Johnston, a Professor of Educational Leadership at Rowan University, who tracked data patterns arising through her research in educational leadership. As a result of this research, the Let Me Learn Process® and the LCI were developed in the early 1990s (Johnston, 1996). Let Me Learn is an advanced learning system through

which an individual finds out how to recognize and express who she or he is as a learner. In the process of understanding ourselves as learners, we develop a vocabulary that enables us to interact more efficiently with our team members and work towards better project completion.

The LCI reflects how we think (our perception), what we actually do (what changes we make as a result of how we're thinking), and how we feel (frequently reflected by what we say). The learning patterns measured by the LCI allow us to determine the combination of several operational learning modes. These four learning patterns are *sequence, precision, technical processing,* and *confluence*. Understanding ourselves in terms of these patterns offers opportunities to develop language that helps us understand how we internalize and process information, and then how we convert that information into communication and actions. Our learning patterns affect how we interact with our classmates, our teams, our teachers, and our partners, whether in classroom situations or in the work world.

Sequence deals with order, planning and organization. *Precision* deals with accuracy, detail and information. *Technical processing* deals with problem solving, relevance and autonomy. *Confluence* is the area that approaches the ideas, the unique thinking, the creativity, and the expression.

As we collect and analyze the LCI data (the inventory produces scores between 7 and 35), we use the following terminology for learning patterns:

Use First – scores between 25 and 35
Use as Needed – scores between 18 and 24
Avoid – scores between 7 and 17

- A Dynamic Learner is a person whose LCI reveals all three categories, *Use First, Use As Needed* and *Avoid* within the four learning patterns.

- A Bridge Learner is a person whose LCI score is between 18 and 24 in all categories. Bridge Learners tend to be versatile, act as facilitators and translators, and are often considered optimum team members.
- A Strong-willed Learner is a person whose LCI scores are 25 or above in at least three of the four learning patterns. Strong-willed learners may be considered as their own committee, or they may attempt to take control of a team.

The pattern characteristics shown in Chart 2 and Chart 3 show the relationship between learning patterns and how we think, what we do, and how we feel for the *Use First (or lead with)* and *Avoid* patterns.

Using the LCI in Education

The College of Engineering has been administering the LCI to incoming Freshmen since 1999. The scores are given to the students, and we provide a seminar on the interpretation and use of the LCI in the initial weeks of the Freshman Engineering Clinic. Students are encouraged to use their learning patterns as they address learning issues with other students or professors.

It is important to develop a vocabulary that learners (promoting intentional learning), professors (promoting intentional teaching), and professionals (managing in the work world), can utilize. The application of a learning instrument that focuses on learning pattern theory helps students increase both their self-awareness and their awareness of their team members. Utilization of the LCI may strengthen teamwork by hastening team role identification. Expanding on Chart 2, consider these examples (and by extension, how Chart 3 provides scenarios for avoidance).

Sequence

Presume that you are working with me and I *lead with* sequence. I'm going to want you to

provide clear directions, preferably step-by-step directions. Sequential people will say: "I like to do my work from beginning to end." "Don't make me quit in the middle." "I want to know if I'm meeting the instructor's expectations." "It's very important to me."

When completing the LCI, there are both multiple choice questions and essay questions. Figure 1 shows an example of essay questions for a student who leads with sequence. Notice the preference for order in the comment that the student is frustrated by changing the original directions. Notice how the responses are numbered. Enumeration or bullets are often apparent when we lead with sequence.

Figure 2 is one of those familiar blue book pages. It's an essay question, and the young college student answering this question is leading with sequence during this test. What he did first was actually very thoughtful. He developed an orderly map showing how he would answer the question, and then he started to write his response. What unfortunately happened in this case was that he ran out of time to finish the exam as a result of needing to be very orderly.

Figure 3 is an example of a younger child. I will use these patrol reports, threaded through this presentation, because they bring home several points very succinctly. Notice the student's enumeration and the LCI scores displayed at the bottom, indicating a preference for sequence.

What do you hear when dealing with someone who needs sequence? "What am I supposed to do?" "What do I do next?" They actually need that next step. The students need to be very clear about process. "Could you repeat those directions?" "Wait a minute!" "Stop, stop, I've got to get that down!" are comments that reflect a preference for sequence.

Precision

Looking at work done by students that lead with precision, we tend to see very complete, very thorough work. Many researchers are very precise as their job depends upon it, and many times the area we work in self-selects for the learning patterns that we prefer. The precise person likes to answer a lot of questions. This is the student that is always ready and willing to offer the answer; they have the information and they want to give it to you. The precise learner may often tell you the same thing several different ways.

Figure 4 is an LCI completed by a student who leads with precision. Note the sequence, precision, technical reasoning, and confluence scores at the top of the page (typically presented in that order, SPTC). The precision score, the second number, is a 30. This student leads with precision and you can notice much more detail is available in the boxes.

Figure 5 is an example of a weekly planner, a log of activities for an adult. This man leads with precision and prefers to note a lot of detail.

Figure 6 is a patrol report for a student who leads with both precision and sequence. This patrol report is not only orderly and detailed, it is lengthy and continues on the back side of the page.

What do you hear from a precise person? "What is this called?" "What is the answer?" "Is the answer in the back of the book?" "Where can I find the answer?"

Technical

We recognize that the technical pattern is the pattern of choice for many engineers. Common statements include "I don't like to write things down," or "I need to see the purpose of what I am doing." Do you want to do your work by yourself? When you're in the lab, would you

just as soon be able to build it and not have somebody interfere with you? Technical people prefer to show you individually what they know, rather than talk about it. Technical people like to figure out problems by themselves.

Figure 7 is an example of a technical person who doesn't like to write things down. Note the 32 score in technical (the third inventory score). This person has said everything he or she wants to say without elaboration. People who lead with technical reasoning are frequently interested in knowing what the relevance of their work is to the real world. They may challenge us on relevance, asking "Why is this important?"

Figure 8 is a page out of a class notebook for a person leading with technical. Note at the very top of the page the date, 1/27, with one line of notes. Then jump to 2/3 and continue with brevity. This person doesn't need to take a lot of notes. People who lead with technical reasoning often don't like to do a lot of writing, unless they are also strong in precision.

Figure 9 is a patrol report from a student who leads with technical with a score of 27 on the LCI. It contains one word and says it all as far as this student is concerned.

What you hear from someone who leads with technical reasoning might include, "Don't make me show this in front of the others." They don't want to be "talked to"; they don't want you to just tell them about doing it, how to do it, or when to do it. "Just leave me alone and let me go do it," may be the feeling you get from the technical person. "What does this have to do with the real world?" is a frequent refrain.

Confluence

As you observe a confluent person, you see tendencies such as a dislike for doing the same thing over and over. Confluent people may see situations very differently than others do. Have you ever been on a committee with others

and as you start to work on the problem, you scratch your head and wonder, "Did they have a different charge than I had?" Leading with confluence, you like to do things your own way, and you don't like following the rules.

Figure 10 shows another example of the LCI in written form from a confluent student. Notice how this person chose to answer the questions, drawing the multiple choice indicators. Would you have thought of doing anything other than checking off your choice?

Figure 11 is a page of notes from a student who leads with confluence. This is from an educational leadership lecture that deals with brain processes and the concepts of cognition, conation, and affectation. Note the eyes at the bottom of the page and the brain matter in this creative presentation.

What you may hear from students who lead with confluence includes "Why can't I do it this way?" or "Who will care if I do it differently?" They frequently have a "better idea" and may be the person who says, "I meant to finish that, but I got involved in something else," or simply, "I forgot." A confluent person may often jump from one area to another. Everything they do is exciting, but they may not stay on task or finish their job.

A Rowan Clinic Example

(from Dahm and Harvey, 2008)

In 2006 the Sophomore Engineering Clinic was divided into six sections of approximately 20 students. All six sections participated in a common three-hour weekly lab, and completed the same design projects and writing assignments. The Let Me Learn® process was implemented in two of the six sections by the writing instructor; the other four sections did not use LML. At the end of the semester, students were given a survey that asked them to rate their agreement with the following four statements on a scale where 1=strongly agree and 4=strongly disagree:

1. My team worked together to DEFINE its project goal(s).
2. My team worked together to REACH its project goal(s).
3. My team RECOGNIZED my skills, knowledge, and abilities.
4. My team effectively UTILIZED my skills, knowledge, and abilities.

In general, students in one of the two sections that received intensive LML instruction had more positive responses than the other sections, and the mean scores of these two sections were more positive than the combined average of all sections. Most importantly, among students with the pattern combination of Use-First Technical Reasoning and Use-First Confluence, the combination that most frequently resulted in low team performance ratings from peers, mean scores were much higher for those who were in LML sections than for those who were not. These findings suggested that in terms of student perception of alignment with their team's goals and team appreciation of their contributions, LML awareness promoted better team relations. This self-assessment was the only hard data collected.

Using the LCI for Intentional Teaching

Let's talk now about intentional teaching strategies, because I'd like to leave you with some thoughts about how we can utilize an understanding of learning patterns in a teaching framework so that students will be more likely to be successful. This also provides students with tools for approaching professors and asking them to teach with strategies that help student learning.

If students need sequence, they want clear, step-by-step directions. It's useful if the professor will provide a model, typically done by providing an example problem. Many teachers already intuitively use these patterns, and I want to provide further vocabulary that will enhance teaching and learning. With sequential students, do not be frustrated when they ask

for repeated directions. They need that repetition; they need to be sure they understand the sequence. They want to process in an orderly manner. You need to allow your students sufficient time to check their work. That means being realistic in terms of what test we are giving and what we are trying to test. Students who lead with sequence respond well to enumerated or bulleted directions as they provide that clear, step-by-step process.

When teaching to precise learners, remember that the students want detailed information and having additional references or URLs available may be useful. If you anticipate the requests for additional information, both faculty and students will be less frustrated. Expect some of the students to write down almost everything that is said. These students may also focus on collecting resource material to the exclusion of getting the assignment done. For example, with a six-week project deadline, three weeks into the project an appropriate question may be, "Have you started writing?" If students are still collecting information, they may not finish on time if you don't encourage them to consider the completed task.

For students who lead with technical reasoning, the intentional teaching strategies have to address issues like understanding the relevance of the assignment or demonstrating the practical applications. These students seek opportunities for hands-on activities, and would actually rather show you their results than complete a written assignment. It's helpful to anticipate that some of these students would rather work alone and they frequently take minimal notes.

An intentional teaching strategy for confluent students includes anticipation. Anticipate that they may avoid reading directions, so they may come with questions that would have been answered had they done so. You might have to gently remind them that they need to read the directions. You need to anticipate a dislike for

repetition, as they may grasp the ideas very quickly, but not want to do the tedious work. Confluent students may also be willing to take more risks, as they may not mind failing. They frequently learn from their failures and they are then ready to move on. "Oh, that didn't work. No big deal." Confluent students may come to you and try to negotiate different ways to complete the assignments. They may want to have you test them orally, for instance, and you may want to consider it.

At Rowan University, a broad spectrum of educators and administrators utilizes the LCI and the Let Me Learn Process®. The campus has observed the College of Engineering success in using the LCI for the past decade. Starting in 2007, the LCI has been administered campus-wide to all incoming Rowan freshman. It is also available to the parents of incoming freshman during freshman orientation. In addition, it is used in Human Resources for training and employee development. All Rowan employees have access to the LCI, which is available online at any time.

One further thought — I am sometimes asked about the relationship of the LCI to learning styles. I would like to point out that learning styles analyses are based on personality. A very powerful test is used to determine the basis for learning styles, the Myers-Briggs, but it is a personality test. The LCI that I have discussed is an inventory of an individual's preferred learning patterns, not their personality. Similarly, the concept of Multiple Intelligences key into learning based purely on cognition, or how we think, not the combination of thinking, doing, and feeling that is captured by the LCI.

Conclusions

If the learning motivation that drives our students is understood, they can be empowered to strengthen habits that will help them become successful and to avoid habits that will hurt their success. Remember that everyone has all of the learning patterns, but there are

differences in the preference levels and how lead patterns are chosen for any particular situation. When we understand our learning patterns, it is not an excuse to avoid a task. It is an opportunity to learn how to harness our learning patterns so that we can successfully complete any challenge.

We have discussed intentional teaching strategies that can assist in teaching development. Students can reveal to their professors where they need assistance. Students and faculty can also promote self-talk and self-learning between each other. Let Me Learn and the LCI provide you with a vocabulary that enables all of us to discover who we are as learners. The LCI also enables us to relieve ourselves (and our students) of guilt about who we are as learners. Each of us has a unique learning combination and no combination is inherently better than another.

This concept is not about intelligence, nor is it about the capacity to learn. Understanding learning patterns addresses how we prefer to learn. Learning in our preferential mode is more likely to be successful and is analogous to using the right tool for a job. The Let Me Learn Process® allows us to reflect on what is happening so that we can take future steps to be more successful. Having a vocabulary for learning encourages students to talk among themselves and with faculty as they strive to succeed. The conversations produce revelations rather than guilt, and understanding learning patterns breaks down barriers and offers paths to solutions. Students become intentional learners and professors become intentional teachers.

This learning process helps each of us as a unique individual with a unique pattern. Understanding these learning patterns and preferences makes us accountable for our own learning. As we accept accountability for our own learning, we take responsibility for what is happening in our educational arena. In the team environment, this knowledge and

vocabulary helps students integrate themselves into the collective needs of the team. When the team comes together, members are better able to identify how everyone can contribute. The process moves students away from clashing within the team because they understand themselves as learners. For example, if everyone identifies as strong-willed learners, and each wants to lead the project but no one wants to write the report, a project challenge is immediately apparent. The team must address this challenge so that the project is completed and a report successfully written. This may require individuals to hold back some of the engineering technical reasoning and forge some of the needed precision to complete the project and write the report.

The process provides a very constructive and creative dialogue for teams, professional colleagues, students, spouses, and partners alike. As Henry Ford said, "Coming together is a beginning. Keeping together is progress. Working together is success." These are the teams one should strive for in education, and in life.

I thank you for your interest and would tell you that my learning combination is not an illness to be cured. My combination has served me well, especially as I've worked to understand myself. I'm particularly pleased that by knowing my learning patterns I recognize personal challenges, and work to understand others as learners. This has allowed me to facilitate better conversations and be more successful in the areas where I've chosen to compete. I also believe that my patterns are a sign of my potential, and I would like to encourage everyone to consider that your patterns are a sign of your potential.

Numbers or scores never uniquely define any of us. We take the LCI for the value it provides and are always willing to build on this inventory. With this final thought, I thank you for your participation.

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I wish to acknowledge the learning opportunities provided by the Learning Connections Resources LLC and Let Me Learn, Inc. I also thank them for permission to reprint LML copyright figures for purposes of illustration.

Learn More

The Learning Connections Inventory (LCI) & Let Me Learn Process is a systematic series of steps that allows individuals the opportunity for innovative self-discovery by learning about how they learn. Its emphasis is on the mind-brain connection and how it works. Beyond simple personality "tests," the LCI & Let Me Learn Process gives people actionable insights that empower them to work smarter, both independently and within team settings by using a common vocabulary and personal strategies.

For additional information on the Learning Connections Inventory and Let Me Learn Process, please visit www.lcrinfo.com and www.LetMeLearn.org.

Additional Reading

Dahm, K., and Harvey, R., (2008). Using Let Me Learn® to Promote Metacognition and Foster Teaming Skills. American Society for Engineering Education Annual Conference Proceedings.

Johnston, C.A. (l996). Unlocking the Will to Learn. Thousand Oaks, CA: Corwin Press, Inc.

Johnston, C.A. (l998). Let Me Learn. Thousand Oaks, CA: Corwin Press, Inc.

Marcellino, P.A., (2005). Bridging Disciplines and Setting Up Diverse Teams. Journal of Behavioral and Applied Management, Vol. 6, No. 3.

Newell, J., Dahm, K., Harvey, R., and Newell, H., (2004). Developing Metacognitive Engineering Teams, Chemical Engineering Education, Vol. 38, No. 4.

Pearle, K.M., & Head, L. M. (2002). Using Your Brain to Build Teams at Work: A Study of the Freshman and Sophomore Engineering Clinics at Rowan University. American Society for Engineering Education Annual Conference Proceedings.

Chart 2
When I Have a *Use First* Learning Pattern

	How I Think	How I Do Things
Sequence	I organize information. I mentally categorize data. I break tasks down into steps.	I make lists. I organize. I plan first, then act.
Precise	I research information. I ask lots of questions. I always want to know more.	I challenge statements and ideas that I doubt. I prove I am right. I document my research and findings. I write things down.
Technical	I seek concrete relevance — what does this mean in the real world? I only want as much information as I need — nothing extraneous. How does this work?	I get my hands on it. I tinker. I solve the problem. I do!
Confluent	I think outside the box. I brainstorm. I make obscure connections. I have unique ideas.	I take risks. I am not afraid to fail. I try new things. I might start things and not finish them.

Chart 2
When I Have a *Use First* Learning Pattern

	How I Feel	What I Might Say
Sequence	I thrive on consistency and dependability. I need things to be tidy and organized. I feel frustrated when the game plan keeps changing. I feel frustrated when I'm rushed.	Could I see an example? I need more time to double-check my work. Could we review those directions? A place for everything and everything in its place.
Precise	I thrive on knowledge. I feel good when I am correct. I feel frustrated when incorrect information is accepted as valid. I feel frustrated when people do not share information.	I need more information. Let me write my answer down so that I am certain it is correct. I'm currently reading a book . . . Did you know that . . . Actually . . .
Technical	I enjoy knowing how things work. I feel frustrated when the task has no real world relevance. I do not feel the need to share my thoughts.	I can do it myself! Let me show you how . . . I don't want to read a book about it; I want to do it! How can I fix this? I could use a little space . . .
Confluent	I enjoy improvisation. I feel comfortable with failure. I feel frustrated by people who are not open to new ideas. I feel frustrated by repetition.	Why do we have to do it that way? Can we try this? Let's bend the rules. I have an idea . . . I have another idea . . .

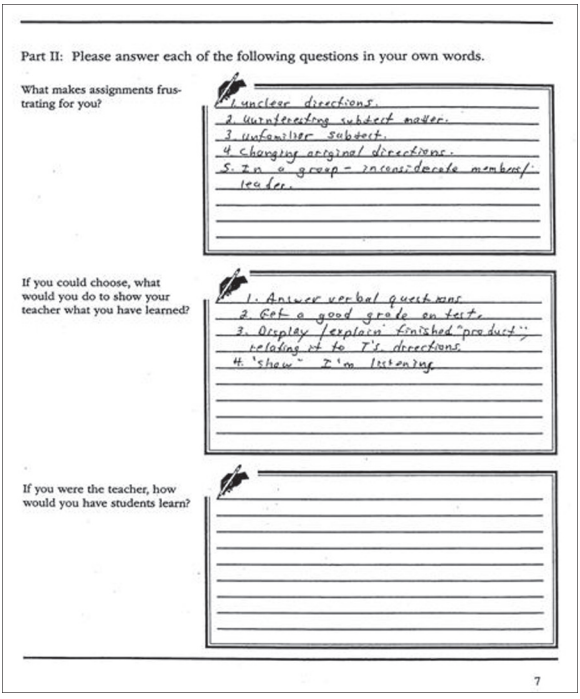
Chart 3
When I *Avoid* a Learning Pattern

	How I Think	How I Do Things
Sequence	These directions make no sense! I did this before. Why repeat it? Why can't I just jump in?	Avoid direction; avoid practice. Can't get the pieces in order. Ignore table of contents, indexes, and syllabi. Leave the task incomplete.
Precise	Do I have to read all of this? How am I going to remember all of this? Who cares about all this 'stuff'?	Don't have specific answers. Avoid debate. Skim instead of read. Take few notes.
Technical	Why should I care how this works? Somebody has to help me figure this out! Why do I have to make something; why can't I just talk or write about it?	Avoid using tools or instruments. Talk about it instead of doing it. Rely on the directions to lead me to the solution.
Confluent	Where is this headed? Where is the focus? What do you mean, imagine?	Don't take social risks. Complete one task at a time. Avoid improvising. Seek parameters.

Chart 3
When I *Avoid* a Learning Pattern

	How I Feel	What I Might Say
Sequence	Jumbled. Scattered. Out of synch. Untethered/Unfettered. Unanchored.	Do I have to do it again? Why do I have to follow directions? Does it matter what I do first? Has anybody seen . . .?
Precise	Overwhelmed when confronted with details. Fearful of looking stupid. Angry at not having the 'one right answer'!	Don't expect me to know names and dates! Stop asking me so many questions! Does it matter? I'm not stupid!
Technical	Inept. Fearful of breaking the object, tool, or instrument. Uncomfortable with tools; very comfortable with my words and thoughts.	If it is broken, throw it away! I'm an educated person; I should be able to do this! I don't care *how* it runs; I just want it *to run!*
Confluent	Unsettled. Chaotic. No more change or surprises, please!	Let's stay focused! Where did that idea come from? Now what? This is out of control!

Figure 1
LCI Written Responses Illustrating Leading With Sequence Pattern



Part II: Please answer each of the following questions in your own words.

What makes assignments frustrating for you?

1. unclear directions.
2. Uninteresting subject matter.
3. Unfamiliar subject.
4. changing original directions.
5. In a group - inconsiderate member/leader.

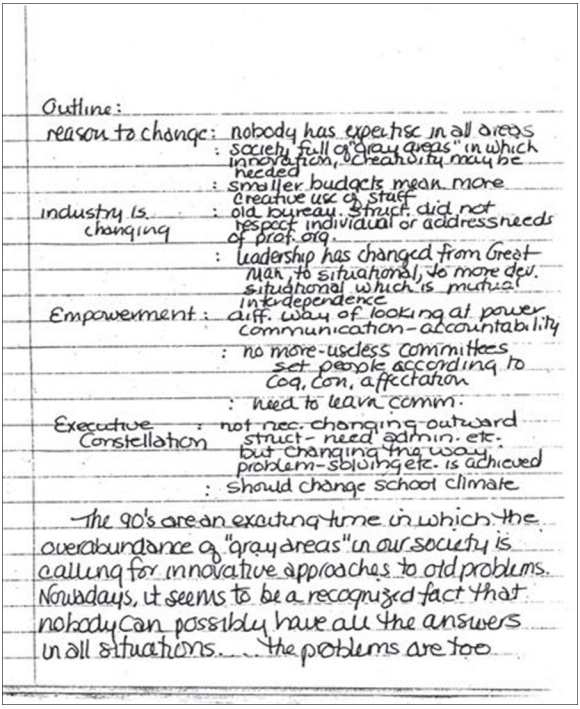
If you could choose, what would you do to show your teacher what you have learned?

1. Answer verbal questions
2. Get a good grade on test.
3. Display /explain finished "product" relating it to T's directions.
4. "show" I'm listening

If you were the teacher, how would you have students learn?

7

Figure 2
Essay Test Example Illustrating Leading With Sequence Pattern



Outline:
reason to change: nobody has expertise in all areas
: society full of "gray areas" in which innovation, creativity may be needed
: smaller budgets mean more creative use of staff
industry is changing : old bureau. struct. did not respect individual or address needs of prof. org.
: leadership has changed from Great Man, to situational, to more dev. situational which is mutual interdependence
Empowerment : diff. way of looking at power communication - accountability
: no more useless committees set people according to Coq, Con, affectation
: need to learn comm.
Executive Constellation : not nec. changing outward struct - need admin. etc. but changing the way problem-sibling etc. is achieved
: should change school climate

The 90's are an exciting time in which the overabundance of "gray areas" in our society is calling for innovative approaches to old problems. Nowadays, it seems to be a recognized fact that nobody can possibly have all the answers in all situations... the problems are too

Figure 3
Patrol Report Illustrating Leading With Sequence Pattern

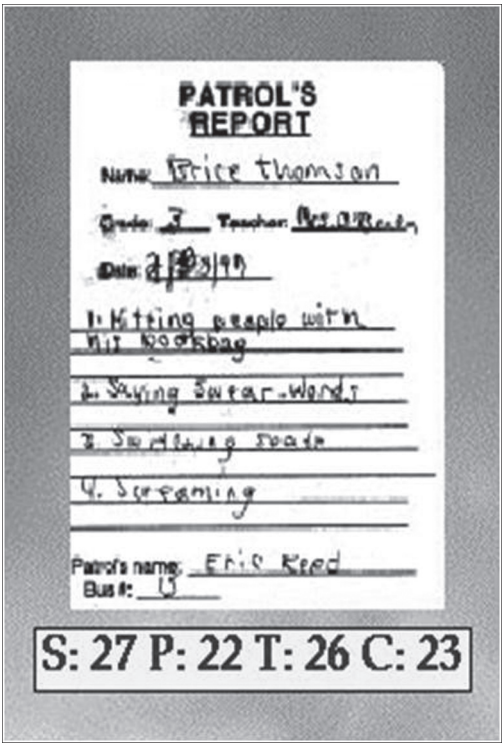
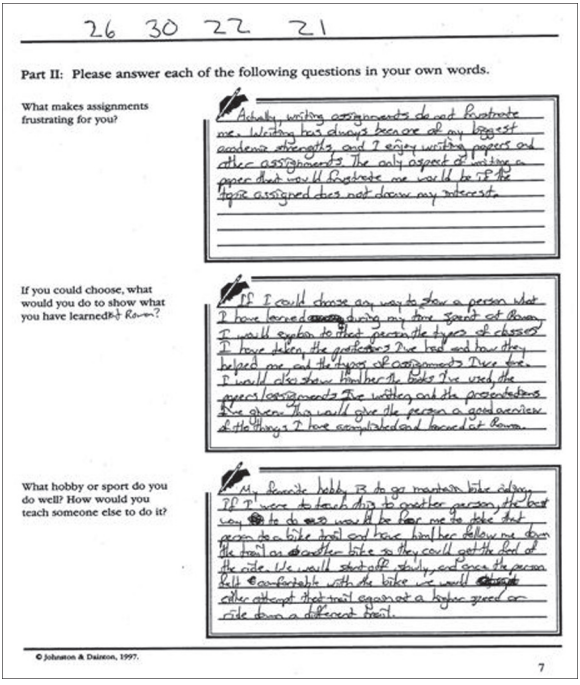


Figure 4
LCI Written Responses Illustrating Leading With Precision Pattern



26 30 22 21

Part II: Please answer each of the following questions in your own words.

What makes assignments frustrating for you?

Actually, writing assignments do not frustrate me. Writing has always been one of my biggest academic strengths and I enjoy writing papers and other assignments. The only aspect of writing a paper that would frustrate me would be if the topic assigned does not deserve my interests.

If you could choose, what would you do to show what you have learned in Room 7?

If I could choose any way to show a person what I have learned during my time spent at Room 7 I will explain to that person the types of classes I have taken, the grades I've had and how they helped me and the types of assignments I have done. I would also show him/her the books I've used, the papers/assignments I've written and the presentations I've given. This will give the person a good overview of the things I have accomplished and learned at Room 7.

What hobby or sport do you do well? How would you teach someone else to do it?

My favorite hobby is to go mountain bike riding. If I were to teach this to another person, the best way to do so would be for me to take that person to a bike trail and have him/her follow me down the trail on another bike so they could get the feel of the ride. We will start off slowly, and once the person is comfortable with the bike we will either attempt that trail again at a higher speed or ride down a different trail.

7

Figure 5
Weekly Log Example Illustrating Leading With Precision Pattern

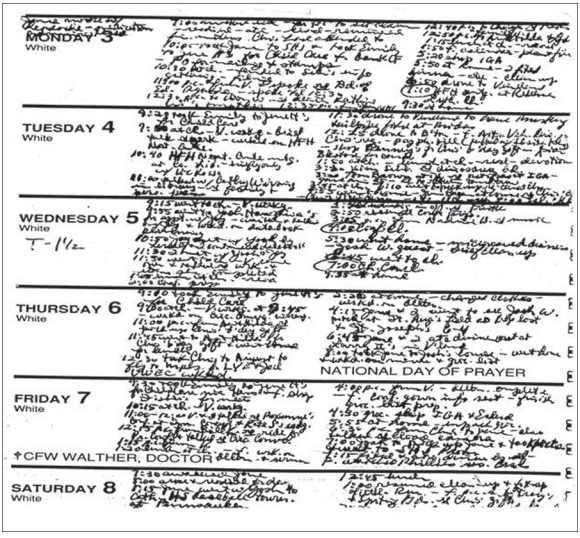
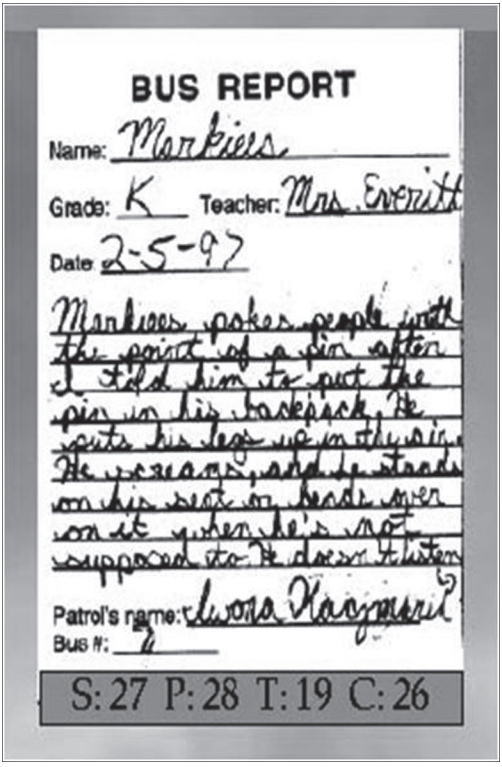


Figure 6
Patrol Report Illustrating Leading With Precision Pattern


BUS REPORT

Name: Markies

Grade: K Teacher: Mrs. Everitt

Date: 2-5-97

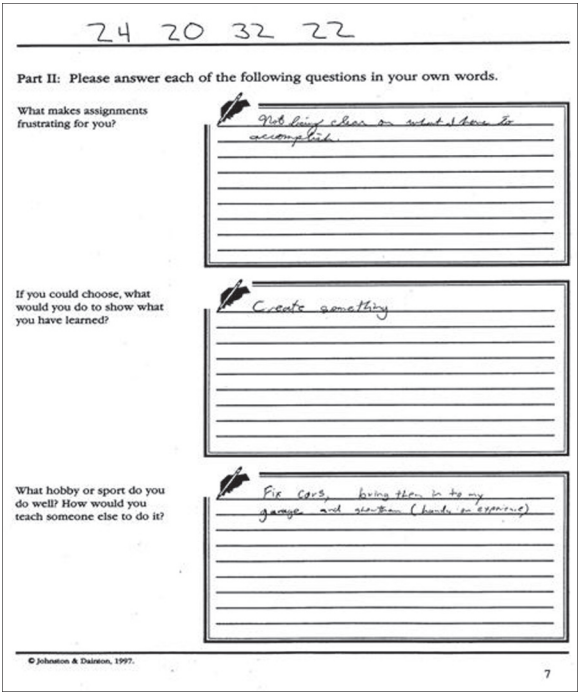
Markies pokes people with the point of a pin after I told him to put the pin in his backpack. He puts his legs up in the air. He screams, and he stands on his seat or heads over on it when he's not supposed to. He doesn't listen.

Patrol's name: Lora Kaczmarek

Bus #: 4

S: 27 P: 28 T: 19 C: 26

Figure 7
LCI Written Responses Illustrating Leading With Technical Pattern



24 20 32 22

Part II: Please answer each of the following questions in your own words.

What makes assignments frustrating for you?

Not being clear on what I have to accomplish.

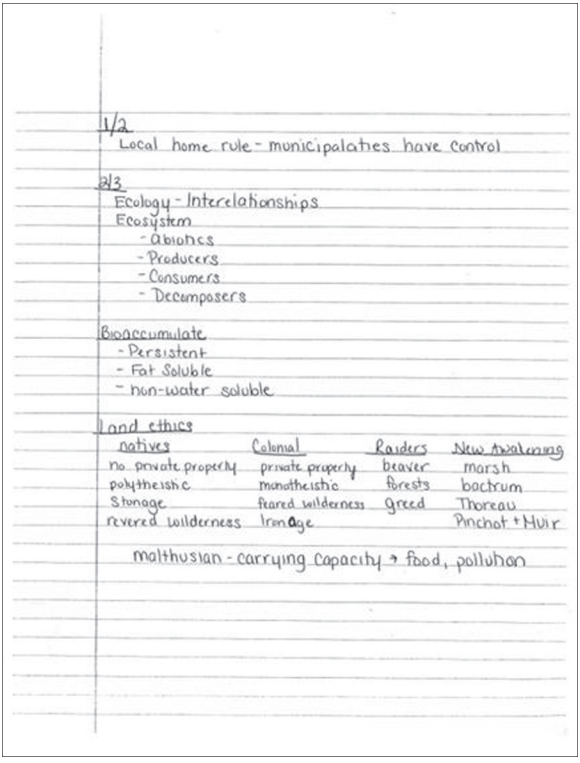
If you could choose, what would you do to show what you have learned?

Create something

What hobby or sport do you do well? How would you teach someone else to do it?

Fix cars, bring them in to my garage and show them (hands on learning)

Figure 8
Course Notes Illustrating Leading With Technical Pattern



1/2
Local home rule - municipalities have control

2/3
Ecology - Interrelationships
Ecosystem
- Abiotics
- Producers
- Consumers
- Decomposers

Bioaccumulate
- Persistent
- Fat Soluble
- non-water soluble

land ethics

natives	Colonial	Raiders	New Awakening
no private property	private property	beaver	marsh
polytheistic	monotheistic	forests	bactrum
Stonage	feared wilderness	greed	Thoreau
revered wilderness	Iron Age		Pinchot + Muir

malthusian - carrying capacity → food, pollution

Figure 9
Patrol Report Illustrating Leading With Technical Pattern

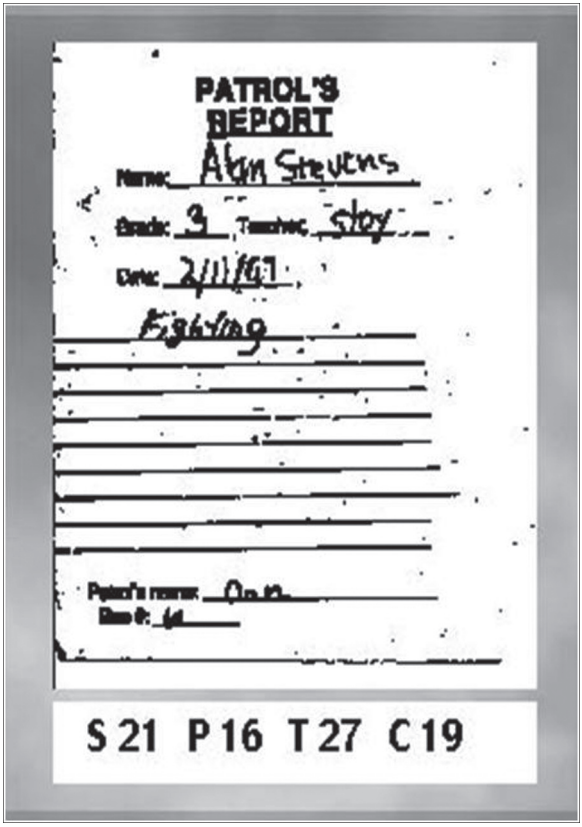


Figure 10
LCI Multiple Choice Responses Illustrating Leading With Confluent Pattern

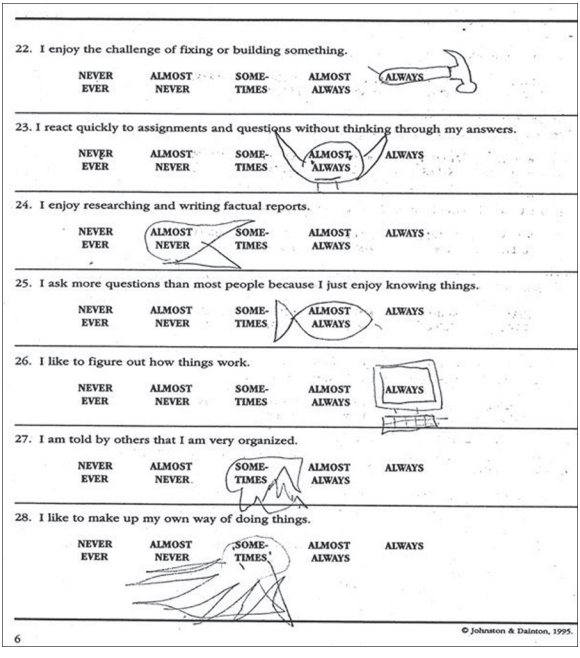


Figure 11
Course Notes Example Illustrating Leading With Confluent Pattern