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A Conversation with Dr. Rita Dunn

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Abstract

Dr. Rita Dunn was interviewed about the field of learning styles. The focus was on aspects not previously reported. This interview addressed how the Center of the Study of Learning and Teaching Styles at St John's University was involved in matching its freshmen students' learning styles with professors' teaching styles. Dr. Dunn provided suggestions on how college and university teaching may be improved when professors introduce various aspects of learning styles into their teaching approach. The No Child Left Behind Act of 2001 provides a basis for Dr. Dunn's comments on student achievement. Dr. Dunn discussed the impact of learning styles around the world. Looking to the future, Dr. Dunn has plans to assist both parents and children in how they can learn about their own unique learning styles and how to apply them. Also, Rita Dunn envisions the learning style movement entering the corporate world where extensive training occurs

Introduction

Rita Dunn was a keynote speaker at The Institute for Learning Styles Research, (ILSR), 2004 Summer Conference, July 22-24, 2004, (Learning Styles and Human Performance, 2004) at Ball State University (BSU) in Muncie, IN, hosted jointly by the ILSR (<http://www.learningstyles.org/>), Indiana Department of Education's Division of Exceptional Learners, and BSU's Department of Special Education. As an outgrowth of that, Dr. Kortland R. Koch (1998, 2004) of the Special Education Department at BSU conducted an interview with Dr. Rita Dunn, Professor in the Division of Administrative Instructional Leadership, Director of the Center of the Study of Learning and Teaching Styles at St. John's University, Jamaica, New York. The setting was at St. John University's summer conference, "The 27th Annual Leadership Certification Institute: Teaching Students Through Their Individual Learning Styles", in New York City, July 29, 2004. Questions had been formulated to ask Rita Dunn to respond to her interest and concern about the field of learning styles that had not been previously reported.

The interview was conducted in person, although Dr. Dunn was aware of the nature of the questions ahead of time. The discussion was audio taped and an assistant took notes. In the late 1990's, Rita Dunn responded to questions from interviewers which covered aspects of the Dunn and Dunn conceptual model,

motivation in learning, children and adult's differing learning styles, intelligence concepts, and her concept of analytic versus global approaches to learning style (Siegel & Shaughnessy, 1996/97; Shaughnessy, 1998).

The formats for those interviews varied; in some cases, the questions were submitted in writing and Dr. Dunn responded in writing and in other instances she gave an oral interview. Rita Dunn views herself as a change agent responsible for promoting and enhancing school effectiveness. For over 40 years, Rita Dunn has been trying to make people aware that students learn in different ways, and therefore teachers and professors must provide multiple strategies to meet the learning styles of all learners so that they can apply learning styles to address the diverse needs of differing individuals. Rita and Kenneth Dunn have together been in the forefront of the field of education, publishing more than three hundred journal articles, chapters and books. Among their books are *Practical Approaches to Individualizing Instruction: Contracts and Other Effective Teaching Strategies* (1972); *Situational Leadership for Principals: The School Administrator* (1983); *The Complete Guide to the Learning Styles In-service System* (1999); and *Teaching Young Adults to Teach Themselves* (2001).

Rita Dunn's belief is that teachers need to learn how to maximize teaching instruction so that students become more efficient learners. The impact of her concepts and their influence on teaching and learning has meant a lot to her. Rita's years of dedication and commitment to instruction is based upon her belief that it is morally wrong to let kids suffer due to a mismatch of teaching and learning styles. Currently the intent of the Center for the Study of Learning and Teaching Styles founded in 1979 at St. John's University is to expand the application of learning styles to other domains and fields. Rita Dunn never dreamed when she first started teaching that she would have made such an impact. She has been dedicated to school change using learning styles and her research to assist teachers. Early in her career, administrators were saying, "I brought you my teachers. Don't talk research; just tell them the practical applications" (Dunn, 2004). Dunn defines learning style as "the way in which each learner begins to concentrate on, process, and retain new and difficult information. That interaction occurs differently for each individual" (Dunn, Dunn, & Perrin, 1994, p.2),

To sit and observe Rita Dunn for the interview was exciting. Her responses presented below do not reflect her dynamic and animated persona. Her physical appearance, gorgeous clothes and beautifully coiffed hair offered a stunning appearance. Adding to that, her expressive eyes, hand gestures and animated voice are aspects of her vibrant personality.

Teaching and Research Practices

1. *How can learning styles help college professors or (school teachers) evaluate their learning and teaching?*

Every year we identify the learning styles of our freshman students coming to St. John's University. Now, for the first year we are going to identify the learning styles of the professors and the teaching styles. We're going to compare and show every professor the learning styles of the students in his/her class as compared with his/her teaching style and learning style. We're hoping it will develop awareness of the fact that they are teaching such diverse kids. You've got to do different things to reach them because one style cannot reach everybody. It doesn't matter how good it is. It's not good for all. So in that sense we're hoping that self-evaluation based on research will cause people to say ... What can I do? Look at all the diverse students. Who can handle all of this? What am I supposed to do? Then we're going to give the professors some easy beginning strategies for responding to different learning styles, not everything, you know, because they would be overwhelmed. You've got 80% low auditory learning people and you're lecturing.

Let them bring tape recorders in and tape record the lecture. Tell them at the very beginning of the semester, I will video tape every lesson. There is no excuse for you not to learn everything. I will have the tapes available. If you are absent, if you're ill, if you can't focus that day, if you can't concentrate, if you get home and there is something you didn't understand, listen to it again. Look at my face, look at what I emphasize, look at what I draw, look at what I illustrate. Make that available to students.

Let them listen to it at their best time of the day. [Let students] listen to it when they can't remember what you said, when they don't remember whether their notes are correct. Tell global students ... that in addition to the notes, draw a picture of what it means. So illustrate it – they somehow remember the pictures that mean something to them. Let them draw pictures of what this is about. Focus them a little bit. Encourage them to bring colored pens in. Use the colors because the colors attract the global consciousness with attention. If the professors start to like it, as some of the professors who are teaching through learning styles, then we'll show them more. See, I think frankly that if a professor is allowed to teach in her style or his style, [they] should have tape recordings of every lesson available in the library, should have ... activity packages in the library, should have a program learning sequence about the [course] content so their kids don't have to learn in the lecture. Every institution puts a great deal of money in the [university] budget for resources but they don't make the right things available to students. You know there isn't a library that doesn't have audio and video tapes, that doesn't have books. But they don't have tapes of the

professors' lessons. Why not have videotapes of professors' lessons? Some [students] have to see the professor's face. That's why they sit in the front. They have to see you [professor], they have to get your meaning, your expression, your actions if you've got actions. So videotape every lesson. Why can't the videotape be available? A kid that misses a lesson or is sick or is delayed by traffic - he never catches up. If professors feel that they are receiving benefits by teaching through learning styles, they're going to want more to help to reinforce their effectiveness as a teacher or instructor.

2. How do learning styles influence course development and the design of lesson plans?

Learning styles influence course development because those of us that are teaching through learning styles are teaching any course through learning styles. So when I am teaching, I've got multisensory materials. I start globally. I tell them what my style is. I am collegial versus authoritative with different students. I never ask just for term papers, I mean that's ridiculous. I make students develop materials. Portfolios, well that's one way. I have them make training materials for different learning styles for anything that they have to learn. So, then they can teach someone else. I let students who are so disposed write articles for publication. They have to write an article for publication persuading people with the research, with practical application, with documentation. Statistics, they're afraid of it. I get my students involved in a real project that I am doing, a real research paper. I teach them the statistics they need to know. That's not my educational specialty. They still have stringent requirements; they still have a final test. I had a doctoral student who went hysterical when she had to take statistics. She said I'm not going to pass. So I said remember your style. Your global. I reminded her of what globals should do. And she passed. You just have to remind them what their strengths are.

3. What are some possible implications for the future of teacher education related to learning styles?

You know we've got to train professors to make potential teachers alert to the fact that good ideas, interesting ideas, should be worked with on small pilot bases, not adopted wholesale. But what happens is that everyone wants to go to conferences. So they go to the major organizations who constantly promote new things. Because they are commercial [materials, companies] make money from selling all these new things. And administrators who are not research alert adopt everything. There's an aura about "We're doing this. This is new." Why are you doing it? Show me the research on it. Why are you not just doing a pilot study with two classes to see if it really has impact? We don't train people like that.

Learning Style's Influence on Professional Standards

4. *What was your involvement in the formulation of P.L. 94-142?*

We started working with children that at the time we called handicapped, hearing impaired, sight impaired, back in the late 60's and early 70's. We began to take methods that we were developing and adapting them with those children. They were really segregated and we tried to adapt. I contributed to the first special ed bill, you know [P.L.] 94-142. I was one that kept talking learning styles. ... The senators laughed because they didn't know what I meant by learning styles. So, the first bill, 94-142, has learning styles requirements in it but many professionals are not doing it the way it should be done.

[States] don't know what they are mandating but they mandate. There are so many laws now, 94 - 142 plus the other laws of special education. They require learning styles diagnosis and educators don't know what they are diagnosing. They are not necessarily using valid and reliable instruments but the laws are requiring them. You can't differentiate instruction anyway other than through learning styles. I see that there is much more awareness, both federal, statewide, and among teachers, but I don't see tremendous depth of understanding. ... How many special ed teachers really understand learning styles? Special education funding requires differentiated teaching and instruction based upon each person's learning style. You can not appropriately implement learning style strategies unless you have a thorough understanding. ... Reading one journal article does not ensure understanding of learning style strategies. ... People need to be trained.

5. *Do learning styles relate to the current initiative of "No Child Left Behind Act of 2001"?*

No Child Left Behind (No Child Left Behind Act of 2001 Executive Summary, Pub. L. 107-110, retrieved August 17, 2004) is atrocious. I don't know where all my colleagues and educators are. No Child Left Behind Act is great icon or theory, just like multiple intelligence, a worthwhile construct, a worthwhile theory. It imposes periodic testing on every school. Show me a single study that shows that increased school testing increases achievement. It doesn't. In some cases, teachers spend more time on the subject, so maybe kids do better. It will make some teachers teach to the test. You know I believe in testing. But you've got to change the instruction if you want increased achievement. [No Child Left Behind Act] has no strategies benefiting teachers. It doesn't tell them what to do. It makes teachers responsible for increased achievement. It doesn't tell the teachers how to do it - no prescription. George Bush could call Rita Dunn and say we have limited funds. Tell me what to do. And I would tell him exactly what to do. Learning styles. Make learning style testing part of every curriculum. It costs two dollars to test for learning styles. It comes with a prescription. Let

teachers see how you do it. Let them see classrooms. There are so many positive things that can be done to improve the system.

Technological Aspects

6. Are there scientific advances that influence learning style research and how does the nature/nurture controversy relate to learning style?

I can only talk about our learning style model. I brought Richard Restak to this conference who wrote *The Brain the Last Frontier* (1979) [(Restak, 2001)]. He says that almost four-fifths of learning style is biological. Whether you need quiet or sound, light or dim light, temperature, how you sit when you learn, your need for mobility, the time of day [you study, he] says is biological. ... This book does show how learning style changes with age, gender. I knew perceptual strength changes dramatically from kindergarten to grade one, to grade two, to grade three, to grade four. But is it biological? ... Whether we learn alone or with peers, that seems to be developmental. Even that changes by age, by achievement level, by gender and the strange thing is by nation. I don't understand all of this yet. It appears you get a higher percentage of auditory learners among Asians. Think about the Asian languages. Do you have to be auditory to really be very verbal?

7. Are specific courses available for students at both the graduate and undergraduate level world wide through the Center for the Study of Learning and Teaching Styles?

At St. John's we have distance learning courses that anyone can take. They can get graduate credit or undergraduate, or they can take it without credit. We make them available to everyone. On campus we have an administration supervision doctorate and the instructional leadership doctorate which focuses on learning styles. The administrative supervision doctorate has 12 to 15 credits of learning styles. I've been showing them you can't send administrators out without the knowledge of these [learning styles]. ... It's knowing how to work differently with different people based on who they are and their styles. Students could come to St. John's and take courses. They don't have to be in a program. At St. John's, we have a Master's that has a lot of learning styles. Through St. John's they can take a course in distance learning which is on-line. It took us more than \$10,000 to develop the first distance learning course. I wanted to do it with learning styles. So we test for learning styles; we analyze students' strengths; we tell them how to study. Everything we teach in five, six, seven different ways so that they can learn in their own style. That is expensive. You've got all kinds of videotapes, interviews, observations.

We did a correlational study when everybody started to go into distance learning. Who does well with distance learning? You've got to look at everybody who signs up for distance learning courses to identify their learning styles. Then

you need experimental studies. What kind of distance learning did they do well with? Who completes it? Who likes it after they have done it? Who really retains it?

The Impact of Learning Styles Around the World

8. What is the state of the learning style field as it is being implemented in schools around the world today?

I think we have established a kind of leadership [at St. John's. People] may not know everything we do but they're aware of it. They know we do learning styles research. For example, we have been able to establish twenty-five centers similar to ours in different parts of the world, certainly many of them in the United States. They're all helping children learn. They're all conducting research. They're all publishing research. In the Philippines three schools are using learning styles. The forty-two schools in Norway were trained by the people who came here to learn but who later became their trainers. So I think the spheres of influence are expanding. We require them to have two certified trainers before they can establish a center. So, if they're coming to us, they still have to get certified and they can only get certified through us. And the reason for that is a lot of people do things differently. I don't want them to train people differently because if they don't understand the method or the strategy, they can teach it incorrectly. We had a speaker today who is the director of a center in Norway. They have forty-two schools that are implementing learning styles. If they are accommodating learning styles anywhere in the world they're doing it the way I taught them to. There can be some slight variations in how they put something together but basically it's the same. We have people here from all over the world today. We've done room redesign, we've done contracts and programs and tactile kinesthetic materials.

The Future of Learning Styles

9. What are the possible implications for the future of teacher education programs in relationship to learning styles training?

I have been trying for twenty years to change teacher education. It changes slowly. We now have proposals in with three foundations. We are going to take school districts with problem children, minority children, in different parts of the country. We have [them] sited in Oklahoma, in Florida, and in New York. We want an elementary, a middle and a high school to volunteer to become learning style schools. We'll do the training, be the trainer. We want to take the children who start in the elementary school and keep them at feeder schools right through the high school. ... We are petitioning state education departments on an experimental basis to take four different endeavors and allow us to take the

trainer, the teachers, those who want to become teachers, and the teacher education groups to work in some schools. I think teacher education has to come out of the college. Look at the age of some of the college professors. I don't mean to be insulting, but they haven't been in (public school) classrooms for years. Kids are different today. The problems are a lot more extensive. We cannot force professors to work in the schools. They think they are doing a good thing – they go in and observe teaching, but they run from teaching methods classes. Teaching, teacher training has to occur in the schools. Students should be taught by the successful teachers who are teaching with learning styles. Now I know that there are educators who are going to be against this. Professors should get into the schools and do the teaching, not observing the teaching and the demonstrations. For twenty years at St John's, we've been demonstrating how to do learning styles in the schools. You know teachers don't change because you tell them in the [college] classroom that they have to incorporate this or that. Teachers don't change because you have had an in-service staff development and then expect them to go and translate your theory and your words of wisdom into practical applications. Teacher training today needs to take place in real life classroom settings so that student teachers can more effectively benefit from actual teaching demonstrations performed by master teachers utilizing effective learning styles instruction. All teachers can change their teaching practices when you work with them in their own classrooms because not only are they working with their own students, but they also see the immediate benefits when effectively employing the learning styles methods. Teachers change when you work with them in the classroom and you let them do it with you and they see you do it. You help them do it and it becomes part of the whole gestalt of teaching. Right now teachers teach the way they were taught, not the way they learn. ... How many teachers come out of classes ... where they really can use learning styles?

10. What role do you see the Center for the Study of Learning and Teaching Styles at St. John's University in assisting both parents and their children?

I want to convert the world, but I'll tell you one thing we're doing next year. Up to now, we have had teachers, school administrators in, and next year for the first time we're having parents and children come. We think that if we can train parents to work with their children and if we can train children to know what their learning style is and how to use it, that will egg on some of the schools to move. I think that if a teacher gives a failing grade to a youngster and he says but look you are making me sit and listen, just give me the opportunity to use my task cards or my flip chutes to learn or do it my own way. I think teachers are going to say what are you talking about and the kids are going to tell them their learning style.

11. What role do you see your institute in assisting business corporations?

Look at the impact of learning styles on corporations and businesses. Everybody needs learning styles. Everybody needs to know how to be the best they can be. We now already have two corporations that are applying to be our centers. These are not school corporations. They became [interested in] centers because they are training people in business. Next year we are having a strand [at the summer institute] for business people.

They need it when they are retraining people. We have two business corporations that are going to be attending our institute next year. Due to this heightened awareness and perceived needs from business corporations, we will establish a strand for businesses. This new strand will help the institute support the expansion and application of learning styles beyond the domain of education. Today's corporate teachers realize that their students learn in different ways. Thus, they need to provide multiple strategies for learning. I am so surprised that learning styles and its applications are moving to other professions as well. I just see the whole thing expanding and I never intended it that way. I had no idea that it would go that way. It has just gotten amorphous and keeps going.

Conclusion

When Rita and Kenneth Dunn began in the field of learning styles they developed a conceptual model of learning styles that they have been fine-tuning for over 40 years. Using that model, they developed the Learning Styles Inventory (Price, Dunn, and Dunn; 1975) which has been part of their research efforts, resulting in published work in the field. Rita's steadfast dedication to the concept of learning styles and her influence on her students is worldwide today. Rita Dunn entered her career as an elementary school teacher and now primarily works with doctoral level students. Her desire to bring the very best to education is a continuing quest. This interview reflects her thinking about the state of education today and its future. She has considered teacher education and how it must change, moving from the ivory towers into classrooms around the world. She feels that the very essence of college teaching must be shaken-up so that professors look at their teaching styles as much as their professional expertise.

Rita Dunn has seen legislative mandates and tried to influence the legislative process. She has personally brought her message to legislators that learning styles are critical to raising standards. She is outspoken today about the No Child Left Behind mandate. Not one to cling to the old concepts, she eagerly seeks out brain specialists and tries to digest recent studies. Rita Dunn envisions the future of teaching and learning from a global perspective. She thinks

beyond her university world to consider corporate education and retraining of those in business. Her extensive research has had a great influence on the movement to transcend learning styles beyond national borders. Now she is concerned about parents and their impact on the learning strategies of their children.

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Cultural Differences and Learning Styles of Chinese and European Trades Students

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Abstract

This article discusses the differences in the learning styles and the approaches to learning by students of Chinese origin, in their first year of tertiary (College or University) study in New Zealand, compared to European students. The research focuses on students doing Electrical and Electronics Trade courses, at Unitec

Introduction

The purpose of this research was to gain insight and hopefully improve teaching methods to cater for the ethnic and cultural diversity of Trades students studying overseas. From teaching experience over many years it appeared that Asian and particularly Chinese students tended to use somewhat different learning methods and styles than those students of European origin. It appeared that in the past groups of Asian international students studying in the tertiary sector in New Zealand often appeared to learn primarily by rote / off-by-heart. Sometimes they memorised large tracts of lecture notes perfectly, and in many cases their level of English comprehension appeared low. Biggs (1996b) however argues that memorising may result in deep learning albeit using an approach regarded as outdated by current Western pedagogy. More recent groups of international students seem to be more fluent to a Western observer, and they demonstrate a deeper understanding of concepts, rather than just words.

The overall aim of this research project was to identify or confirm classroom observations of learning methods, and if there were any significant differences in approaches to learning between Chinese and European Trades' students. Because of the large proportion of Chinese students, it is reasonable to question whether their learning methods and hence teaching methods might (or should) be different to reflect differences in their culture and / or upbringing.

The research question has been refined and limited to reflect the predominant group of Asian students in classes. The field of study has also been narrowed to include the Trades area that Unitec Applied Technology Institute covers, but not overly restricted to Electro Technology department, as this would unduly limit student numbers.

Literature Review

This literature review covers two areas, students' approaches to learning, and the methods / instruments used to measure learning styles. Ideas about Asian students' learning styles have changed since Ballard and Clanchy (1991) who assumed Chinese students' use of repetition involved learning by rote and therefore only surface learning occurred. Biggs (1996b) seminal work has produced many publications countering their earlier arguments, and other researchers such as Kember (1998) and Entwistle and Ramsey (1983) have shown that Chinese students use repetition as an aid to gain deep levels of understanding.

Kember and Gow (1989) suggest that memorisation helps reduce the workload when studying in a foreign language. The paradox is that Chinese students' achievement level is often higher than European students despite a class pedagogy widely regarded as outdated by current Western teaching philosophy. (Biggs & Watkins, 2001).

Western educational theory currently favours a constructivist approach, where students construct (build) their own knowledge, merely facilitated by the teacher. In a Confucian Heritage Culture (Biggs & Watkins, 2001) the teacher is generally well respected with all the wisdom, a mentor, guide or maybe even guru figure for the students who are the apprentices. This knowledge is imparted to the students. Imposing Western pedagogy on such a cultural background, such as the introduction of the Target Oriented Curriculum into Hong Kong has met with a lack of success (Boekaerts, 1998).

Experience has shown Chinese students do not tend to ask as many questions as Western students (Biggs, 1996a). In Chinese culture questioning may be seen to represent a challenge to the teacher (Ginsberg, 1992). However Chinese teachers assume the role of mentor and role model far more so than Western teachers. They interact with students after class in a more informal mode (Stevenson & Stigler, 1992) far more than their European counterparts. It would also be incorrect to assume that Chinese classes are entirely teacher centred. Student participation can include rapid fire questions by the teacher, answered by one student on behalf of the class while the other students participate by listening and tend to follow a sequence of Initiation, Response and Follow-up to reinforce the learning (Cortazzi, 1998).

Ng, Tsui and Marton (2001) observed an interesting difference in classroom technique between two identical classes taught by the same teacher; one in English for higher band / level bilingual students and the other in Chinese to lower level students with less English comprehension. They observed that the class in Chinese, far from occurring at a lower academic level, actually contained significantly more open ended questions, and received better student responses to such questions than the English class, which was perhaps limited by both the students' and teacher's mastery of the English language.

One study has shown (Watkins & Biggs, 2001) that Western students tend to believe understanding occurs as a sudden insight, and academic success is primarily related / attributed to innate ability (perhaps related to IQ). Chinese students on the other hand tend to attribute understanding, and hence academic success primarily to effort. This can have both positive and negative consequences. The Chinese view promotes serious study, students paying strict attention in class and other behaviours likely to gain positive learning outcomes. However, if a student does not succeed in a particular course of study for reasons beyond their control, self blame, shame and even suicide may result (Dweck & Grant, 2001).

Recent studies (Chan, 1999; Woodrow & Yuen Mei, 2001) and even a local study (Robinson & Kuin, 1999) provide insight into the different learning styles and practices of Asian and in particular Chinese students studying in a European country. They provide a cultural context for the Chinese approach to copying material for assignments, both from colleagues and from external sources such as the Internet. The Chinese regarding copying as a valid method of learning, as opposed to the popular Western view which regards such copying as plagiarism and cheating.

Methods

Research styles and methods in the construction industry, a related trades area has also been the subject of at least two local books (Fellows & Liu, 1997 , Naoum, 1998). These have been instructive to help focus on a research question, and choose a suitable method / instrument to answer that question.

In evaluating which instrument would be most effective for this project Coffield, Moseley, Hall and Ecclestone (2004) has provided guidance. They evaluated thirteen of the most influential learning styles models, and rated them for four factors, namely internal consistency, reliability, construct validity and prediction validity. Although Allinson and Hayes (1996) rated positively on all 4 factors, their Cognitive Style Index is primarily designed for analysing business relationships, particularly manager – subordinate, and has a single scale from Intuition to Analysis. Therefore it was regarded as inappropriate for this purpose.

Reversal Theory (Apter, Mallows, & Williams, 1998) rated well except for construct validity; however apart from challenging the notion of fixed learning style preferences, there is no evidence of its pedagogical impact, and therefore also unsuitable for this research project. The PEPS survey (Dunn, Dunn, & Price, 1996) rated poorly except for predictive validity, despite its wide promotion and use. Learning Styles Inventory (Kolb, 1999) has been globally influential but rated well only on retest reliability, and the Learning Styles Questionnaire (Honey & Mumford, 1982) although also widely used, again rated well only in retest reliability. The Inventory of Learning Styles (ILS) (Vermunt, 1994) however rated well in all factors except predictive validity. To complete the survey of possible instruments a series of perhaps lesser known online questionnaires was investigated, however none

compared with the ILS (Vermunt, 1994). Therefore the Inventory of Learning Styles was chosen for this research project. Although an early version of the questionnaire is freely available on the Internet, the author's permission for use of the updated version for this study was obtained.

The reason a quantitative questionnaire, rather than a qualitative method such as a focus group was chosen, is mainly that it is less intrusive for the participants. Students are more willing to participate in a 10 – 20 minute questionnaire than an interview or focus group. There may also be student reluctance to participate in individual interviews or focus groups, particularly with a lecturer from a different cultural background. Future qualitative research could be indicated to illuminate any resulting questions arising from this study.

Use of an existing, well proven questionnaire avoids any pitfalls in designing a new instrument (Cohen, Manion, & Morrison, 2000). There are many questionnaires available in this field and in the early stages of this project the PEPS survey (Dunn et al., 1996) was considered, but the logistics of processing the results overseas in USA made the PEPS survey impractical for this research. The additional cost of processing the results would also need to be considered.

The pilot study for this project used the Learning Styles Questionnaire (Honey & Mumford, 1982), with a small sample of lecturers as subjects. However Inventory of Learning Styles Questionnaire , (Vermunt, 1994) proved to be the most appropriate for this research project and provided a much greater quantity of data covering a much wider range of learning styles and modes than the Honey and Mumford questionnaire. Having tested the questionnaire myself it required 10 minutes to complete, however the subsequent student completion time ranged up to 25 minutes. One student did not fully complete the questionnaire and as a result his data was unusable and was not included.

Unitec Research Ethics Committee approval was sought and gained, involving the moderation not only of the questionnaire itself, but accompanying participant Information Sheets and Consent Forms. Copies of the questionnaire and accompanying forms are available from the author by request.

The research participants / subjects in this study were Unitec students, studying in the Trades areas at Unitec Applied Technology Institute. The sample size consisted of four separate classes of students giving total sample size of 44 students. Participation was voluntary and anonymous.

The Inventory of Learning Styles questionnaire has 120 questions each scored on a rating of 1 to 5. It is divided into 3 sections. Part A measures Study Activities, Part B1 : Study Motives, and Part B2 : Study Views. There are 56 questions in Part A, using a 1 to 5 rating scale denoting the frequency of the Study Activity. 1 means "I do this Seldom or Never" ranging up to 5 which means "I do this Almost Always". Part B1 contains 24 questions and Part B2 an additional 40 questions, both measuring

the agreement or otherwise to a given statement. In these sections 1 means “I Disagree entirely” ranging up to 5 which means “I Agree Entirely”.

The results of each questionnaire are totalled into 20 separate categories as shown in Table 1. These are organised into 4 main categories and 16 sub categories 5 of which are further subdivided into 9 sub scales as shown in Table 1.

Table 1
Categories and Sub Scales

Main Category	Sub Categories	Sub Scales
Part A Processing Strategies	Deep Processing	Relating and Structuring Critical Processing
	Stepwise Processing	Memorising and Rehearsing
	Concrete Processing	Analysing Application
Regulation Strategies	Self Regulation	Self Regulation of Learning Processes and Results Self Regulation of Learning Content
	External Regulation	External Regulation of Learning Process External Regulation of Learning Results
	Lack of Regulation	
Part B1. Learning Orientations	Personally Interested Certificate Directed Self Test Directed Vocation Directed Ambivalent	
Part B2. Mental Modes of Learning	Construction of Knowledge Intake of Knowledge Use of Knowledge Stimulation Education Co-operation	

Table 2

Results

Sub Category - Sub Scale	Significance
Deep Processing – Relating and Structuring	0.287
Deep Processing – Critical Processing	0.463
Stepwise Processing – Memorising and Rehearsing	0.043
Stepwise Processing – Analysing	0.303
Concrete Processing	0.559
Self Regulation of Learning Processes and Results	0.332
Self Regulation of Learning Content	0.137
External Regulation of Learning Processes	0.019
External Regulation of Learning Results	0.038
Lack of Regulation	0.947
Learning Orientations – Personal Interest	0.436
Learning Orientations – Certificate Directed	0.156
Learning Orientations – Self Test Directed	0.032
Learning Orientations – Vocation Directed	0.027
Learning Orientations – Ambivalent	0.009
Mental Modes of Learning – Construction of Knowledge	0.074
Mental Modes of Learning – Knowledge Intake	0.012
Mental Modes of Learning – Use of knowledge	0.022
Mental Modes of Learning – Stimulating Education	0.223

Note: A significance level of less than 0.05 is regarded as significant.

The 44 students surveyed consisted of students from four classes of the Certificate of Applied Technology, both Levels 3 and 4. They comprised a mix of nationalities, with a large majority of 25 Chinese students, 7 New Zealand students, and the balance including 3 Fijian Indian, 3 Korean and also single students of the following nationalities : Indian, Persian, Burmese, Peruvian, Bangladeshi and one unspecified Asian. Only the Chinese and New Zealand students' results have been

included in the comparison and the other nationalities' results have been set aside for a future, wider study. The average score for each of the sub categories or sub scales was compared between the Chinese and New Zealand students (only). Analysis was conducted initially using an MS Excel spreadsheet, and subsequently in more detail using SPSS statistical package. The use of SPSS allowed a more detailed ANOVA test, which resulted in some sub scales showing a statistically significant difference between the nationality groups where no difference was initially apparent or obvious using the simpler Excel analysis.

The processing strategies described in Part A of diagram 1 categorise the ways of dealing with material to be learned. Some students may prefer to make lists, others summaries. It has been commonly assumed that New Zealand students and teaching methods favour deep processing, whereas Chinese students and teaching methods favour stepwise processing. Processing the material step by step very thoroughly with an eye for detail and learning the factual information completely by heart was regarded as a common Chinese learning method. However the results show an insignificant difference between the two groups with both groups favouring deep processing, and the Chinese group rating slightly higher in all sub scales, except concrete processing. New Zealand students show a slight but statistically insignificant preference to link their learning to the world around them using examples from their experience and everyday life.

Chinese students showed slightly higher regulation strategies in all areas, both self and external regulation, with the single exception of Lack of Regulation, where both groups scored equally. This may indicate that Chinese students have a better study ethic than New Zealand students. However there were two sub scales showing the greatest significant difference between the two groups. The first was External Regulation of Learning Processes, indicating a preference by Chinese students for teacher guided study, primarily using textbooks. This may be expected as Chinese culture and students tend to show more reliance and obedience to teacher instruction than New Zealand students. The other sub scale with less of a marked difference was External Regulation of Learning Results, where again Chinese students scored significantly higher, maybe indicating Chinese students' strong focus on assessment and passing the requirements of the course.

In part B1, terms of learning orientation / motive the two groups scored similarly for most sub categories. Chinese students rated slightly but significantly higher for self test directed, indicating a desire to show yourself and others that you can succeed. New Zealand students scored higher for vocation directed, probably having a more immediate profession or job pathways motivating their study. This compares with many Chinese students whose choice of study (towards a vocation) may be strongly influenced by family, cultural or other outside factors. It has been recorded that a number of Chinese students who recently completed an entire one year certificate or three year degree course in one particular trade, then subsequently re-enrolled in the same certificate or degree course majoring in a different trade area. Perhaps unsurprisingly, this lack of focussed direction is reflected in Chinese students

scoring significantly higher in the ambivalent sub category. In fact this sub category showed the highest level of difference between the two groups.

In part B2, the mental modes of (opinions about) learning the New Zealand group scored statistically higher for knowledge intake and for use of knowledge. This indicates New Zealand students tend to accumulate knowledge both within and outside the classroom, often using their own initiative rather than relying on the teacher, and furthermore they are continually looking for ways to put their knowledge to work. They want strong links between theory and practice.

The Chinese group scored higher in the other mental modes of learning, namely construction of knowledge and stimulating education. Interestingly the last sub scale namely Co-operation shows very similar results for the two groups. The commonly held perception of Chinese students working together far more than New Zealand students is not reflected in this score.

Discussion

The results of this questionnaire show that Chinese and European students have similar attitudes towards their study and use similar study methods, albeit with some small but significant differences. Chinese students are more result focused, or sometimes ambivalent about their learning, whereas New Zealand students are more vocation focused. Some New Zealand students see their study as (only) a means to an end, and often ask "What job can I get when I complete my course?" or even "Do I need to know / learn this for a job?" Chinese students on the other hand are more self-test (result) focussed and would instead tend to ask "Will this be in the exam?" or "Can I resubmit this assignment to get a better mark?"

Chinese students rely on more external regulation of their learning processes and results (Biggs, 1996a). This is in line with Confucian Heritage Culture, where the teacher or lecturer strictly controls the learning environment and content, and is regarded as the font of all knowledge. In contrast New Zealand classrooms are much more student centred, with the student having a large degree of control over their own learning, and the teacher regarded more as a facilitator than a teacher.

Conclusions

The most obvious conclusion made from this study is that there are less differences between the two student groups than might have been previously thought, given the differences in cultural beliefs and pedagogical history. This may be for a number of reasons. Increased globalisation, communication and joint educational research particularly in such places as Hong Kong with a mixture of Chinese and British heritage, has led to a cross fertilisation of pedagogy with hopefully the best practices of both cultures being adopted.

This study may also be influenced by the sample group of Chinese students being studied are those who have chosen (for whatever reason) to study abroad in a Western culture. This obviously shows willingness by the students (and their families) to be influenced by Western culture to a large degree, compared to Chinese students studying at home. The results of a similar study performed in the students' home country may well be different.

In the past, it has been commonly assumed that Western (pedagogical) ideas are more modern than Confucian Heritage Culture teaching methods (Ballard & Clanchy, 1991), however more recent studies have shown otherwise (Biggs & Watkins, 2001). Similarly, efforts to impose Western education methods on Chinese students have met with failure (Boekaerts, 1998).

It may be that the future lies with creating partnerships between East and West on a more equal basis. For example Unitec's Electro Technology department and a Shanghai university have recently instituted such a reciprocal arrangement, and a visiting Professor from China is currently spending a semester at Unitec undertaking joint research, and supervising research students. This is to be followed by one of our staff members teaching in Shanghai over the coming summer. Such cross fertilisation can only benefit both institutions, improve the research outcomes and pedagogy in both Chinese and New Zealand institutions and promote a better cultural understanding between China and Western countries such as New Zealand. As this research has shown Chinese and Western students have far more in common than their perceived differences may have suggested in the past.

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Examination of Pre-Service Teachers' Learning Styles and Temperament Styles within an Elementary Science Methods Course

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Abstract

Pre-service teachers enrolled in an elementary science methods class were introduced to teaching strategies that enhanced how students learn in different ways. While their major content focus was science, they were instructed in the understanding and use of learning styles and temperament styles as it applied to teaching science. Elementary pre-service teachers in methods courses enter into their teacher education program with different levels of motivation, attitudes, and ideas about teaching and learning. Many times they are not prepared to deal with classroom environments and instructional practices. This study introduced pre-service teachers to learning styles and temperament styles models. Inventories of each were given to pre-service teachers for the assessment of their own learning style and temperament style. Pre-service teachers, once made aware of their learning and temperament styles, were better able to identify student differences, meet the needs of diverse learners, and enhance classroom instruction.

Introduction

When the No Child Left Behind Act was adopted in 2001, there was an increased focus on student achievement and how students learn and behave. Teachers were faced with the construct that every child can learn and adopted strategies for reaching that goal. As a result, teacher preparation programs in schools of education placed emphasis on training teachers in various methods of instruction. Teacher preparation programs accredited by the National Council for Accreditation of Teacher Education (NCATE) met national standards that emphasized the following:

- Knowledge of subject matter and a variety of ways of teaching all students to learn;
- Encouragement of students ability to think critically;
- Creation of a supportive environment to encourage active interest in learning;
- Classroom management of students who vary in learning styles.

Being accredited by NCATE symbolizes colleges of education's dedication to producing high quality teachers. As a result of the NCATE standards, the researchers of this study sought to implement these standards through the introduction of learning styles and temperament styles. NCATE standards are aligned with the research of understanding how children learn and children's preferences for learning.

Students bring to the classroom different attitudes, learning styles, and assumptions. (Cofffield & Moseley, 2004a; 2004b; Duff, 2002; Duff, 2004; Dunn & Griggs, 2000; Felder & Silverman, 1988; Kolb, 1984; Kolb & Kolb, 2005). Students tend to focus on facts, data, and algorithms. Some respond strongly to visual forms of information and many others prefer to learn actively and individually. Functioning effectively requires working well in a variety of learning styles models (Felder, 2005; Svinicki & Dixon, 1987).

Purpose of the Study

The purpose of this study was to introduce pre-service teachers in an elementary science class to learning styles and temperament styles as it relates to an additional teaching tool and strategy. This awareness and understanding of how students learn, helps pre-service teachers make better decisions in teaching strategies because students learn in different ways. The introduction of temperament styles and learning styles support pre-service teachers' awareness of their learning and temperament traits in relation to students' learning styles and temperament styles. In knowing their own styles and traits, they recognize that students may not process information in the same way as that of the teacher thus providing a barrier to student learning and achievement. This awareness and understanding of learning styles and temperament styles will be an added teaching tool to encourage confidence in the teaching of science in the classroom.

Learning Styles and Temperament Styles

Mismatches occur between students and teachers when the teacher is not aware of the student's learning styles and temperament styles. Keefe (1982) defined learning styles as characteristic cognitive affective and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with or respond to the learning environment.

Dunn and Dunn (1992) suggest that research on learning styles provides direction for either how to teach individuals through their styles, patterns or how to teach them by capitalizing on their personal strengths. Learning style can also be defined as the way in which each learner begins to concentrate on, process, and retain new and difficult information. (1992). Identifying learning styles and adapting lessons

can motivate, encourage students to succeed, and eliminate unfair labeling. Different individuals perceive and process experiences in different preferred ways (Brokaw & Merz, 2000; Dunn & Dunn, 1989; Dunn, Griggs, Olson, Beasley, & Gorman, 1995; Felder, 1993; McCarthy, 1981).

Students' unique learning styles are comprised of these preferences. McCarthy (1981) identified three basic types of learners; visual, auditory, and kinesthetic. Visual learners process information through sight (pictures, models, diagrams, demonstration, and other visual aids). Auditory learners use hearing as their main source of information. Their preference is lecture, discussions, and listening to others. Kinesthetic learners prefer hands on approaches to acquire knowledge. This type of learner likes to explore the physical world by touching and movement (McCarthy, 1981).

Temperament can be defined as a solid core of traits of one's personality that reflects the unique essence of a particular human being. Bryce (2002) suggests that temperaments are built on the interpretation of life, code of behavior and a mystery of understanding. Temperament points us each in a particular direction and makes us uncomfortable when we deviate from it.

At birth, individuals are equipped with fundamentally different temperaments or dispositions to act in certain ways. It was suggested that people's patterns of attitude and action are inborn as their body develops (Keirsey, 1998).

One may propose that people communicate in different ways, have different mating, parenting, and learning styles. They desire to learn different things at school and excel differently at work (Keirsey, 1998). There seems to be a lot to gain by appreciating these differences and a lot to be lost if we ignore them or condemn them. The first step to understanding differences is for one to understand one's own personal traits, whether it is learning styles or temperament styles.

Nelson (2002) discusses the learning nexus. This learning nexus is the point at which all learning styles incorporate elements of learning. It is a common ground, the connecting point that all learners share. When we can learn to focus our teaching in this area, the nexus, we can be confident that our teaching is going to reach the learning styles of each of our students. "If we stand firmly, where all learning preferences overlap, we have the best likelihood of meeting the learning needs of our students and the curricular needs established by our districts" (Nelson, 2002, p. 155). Nelson in his work *The Aristotle Effect* found that too often teachers who are determined to reach certain individuals in their classes forget about their need to meet the learning needs of all class members. There is a need for balance within the learning style as well as the temperament style when instructing students. No one lesson should focus on only one learning style or one temperament style. Teachers should strive for balance in their instructional methods. If balance is functioning in the classroom then students will be

instructed in ways that incorporate all of the learning styles preferences which could enhance increased comfort level, willingness to learn, and improved student achievement.

In college teacher preparation courses learning style models along with that of temperament models should be taught for the purpose of preparing new teachers to discover that students do have different learning styles and temperament styles. If pre-service teachers understand these differences and incorporate them into the classroom, teachers can be more effective educators and students can become better learners (Bryce, 2002).

Why did the researchers then look at introducing learning styles and temperament styles in the science classroom? Elementary pre-service teachers are typically not prepared to teach science content. They often fear not knowing the content sufficiently, not feeling confident enough to conduct science demonstrations, and not prepared to create or design science activities for the classroom (Prairie, 2005). The preference in science is to teach in an inquiry and discovery method which has attributes of hands on activities. However, there are students who prefer learning through, lecture, listening, and demonstrations. Understanding the use of temperament styles in the science classroom allows students to participate in cooperative learning groups, individual and independent learning, inquiry and discovery, and creative drama. Bryce (2002) indicated that when temperament styles are included in the classroom, magic transpires and every ones preferences are accommodated. This magic in the classroom encompasses the teacher meeting the learning and temperament styles of the students.

Learning Styles and Temperament Styles in the Science Classroom

The Felder-Silverman Learning Style Model was used effectively in engineering education and the sciences (Felder & Spurlin, 2005). Felder and Silverman's model is based on strategies that present information that appeals to a range of learning styles (Felder & Silverman, 1998). These strategies are:

- Teach theoretical material by first presenting phenomena and problems that relate to the theory;
- Balance conceptual information with concrete information;
- Make extensive use of sketches, plots, schematics, vector diagrams, computer graphics, and physical demonstration in addition to oral and written explanations and derivations in lectures and readings;
- Illustrate an abstract concept or problem solving algorithm, use at least one numerical example to supplement the usual algebraic example;
- Use physical analogies and demonstrations to illustrate the magnitudes of calculated quantities;

- Provide class time for students to think about the material being presented and for active student participation;
- Occasionally give some experimental observations before presenting the general principle, and have the students see how far they can get toward inferring the latter.

Typically in engineering classes students are viewed as passive and not seen as active or reflective. Felder and Silverman suggest to improve test scores, reduce hostile classes, poor attendance and drop outs, it is necessary that a teaching style that is both effective for students and comfortable for the professor is implemented.

As a result, this model was chosen to be implemented in the science elementary methods course. Based on various applications of the model by other researchers, one being Susan Montgomery, assistant professor of chemical engineering at the University of Michigan this model has had documented results with achievement, and usefulness in preparing students to learn in engineering and the sciences. Felder and Silverman (1988) classified students as:

- Active and reflective learners (learn by trying things, learn by thinking things through);
- Sensing and intuitive learners (concrete, practical, oriented towards facts and procedures, conceptual, oriented towards theories and meanings);
- Visual and verbal learners (prefer visual representations, prefer written and spoken communications);
- Sequential and global learners (linear, orderly, learn in small incremental steps, holistic, systems thinkers, learn in large steps).

Nathan Bryce (2002) developed the Insight Temperament Instrument TM, a temperament inventory based on extensive research and experimentation of the Myers-Briggs Type Indicator (MBTI) and the Keirsey Temperament Sorter. Bryce (2002) suggests that this temperament inventory can be used in the classroom as a tool to increase respect and sensitivity to the needs, values, and attitudes of others. This tool identifies an individual's temperament profile as four archetypal temperaments from which all personality styles are derived (Bryce, 2002).

These temperaments are symbolized by color: blue, gold, green, and orange. Each color has clear preferences on how one likes to learn information as it relates to favorite subjects, idea classroom environment, motivation to learn, sources of esteem, testing, and individualized learning styles. The temperament spectrum includes:

- Blue characteristic learners (likes activities that emphasizes cooperation, values close relationships, thrive on interaction and dialog);
- Gold characteristic learners (dutiful and stable, value order and organization, are responsible and dedicated);

- Green characteristic learners (innovative and logical, require intellectual freedom, value concise communication);
- Orange characteristic learners (active and competitive, talented resourceful, skillful, and adaptable, value visual, verbal, and hands on activities).

Methods

This study involved 28 female elementary pre-service teachers enrolled in a science elementary methods course at a rural southeast university. The goal of the study was to introduce pre-service teachers to learning styles and temperament styles. A class assignment was given to the 28 pre-service teachers so that the pre-service teachers would be able to identify their learning/temperament style and to observe students learning/temperament styles. Pre-service teachers observed students during their field experiences who exhibited certain learning styles and temperament styles. From their observations, pre-service teachers chose teaching strategies that aligned with how students learned and their preferences for learning associated with their temperament styles. Pre-service teaching styles were modified based on observations of student's learning styles. Their class assignment included lesson plans with activities aligned with the teaching strategies of Felder's Learning Style Model and Bryce's Insight Learning Temperament Model.

After the pre-service teachers taught their classes, they participated in a class discussion of what they learned from their experiences. Pre-service teachers reflected in a final paper about how the introduction of learning styles and temperament styles made a significant impact on instruction and student learning.

The Felder-Silverman Learning Styles Questionnaire was administered to 28 pre-service teachers. The survey results indicated that, 14 were active, sensing, visual, and sequential; 5 were reflective, intuitive, verbal, and global; 6 were active, intuitive, visual, and sequential; and 3 were active, sequential, verbal, and global.

Bryce's Insight Temperament Instrument was administered to 28 pre-service teachers to determine their color spectrum. The color spectrum is defined as their primary temperament, secondary temperament, third and fourth temperament, all of which have characteristics that defines an individual's behavior. Out of the 28 pre-service teachers participants; 19 were determined to be cooperative, organized, logical, and active; 3 were determined to be organized, active, cooperative, and logical; 3 were determined to be active, organized, cooperative, and logical; 2 were determined to be cooperative, logical, organized, and active; and 1 was determined to be logical, cooperative, active, and organized. All of which falls within the characteristics of the color spectrum.

Findings

Based upon the discussion in the science methods class and exposure to the learning/temperament styles instruments, pre-service teachers found that their observations of students' learning styles and temperament styles and their own teaching methods and learning/temperament styles were useful in teaching science. The students reported their findings in a five page paper, using a rubric which identified theory, instruments, and the color spectrum. The following comments suggest how pre-service teachers bring into being the knowledge and exposure to learning/temperaments styles and the usefulness in the elementary science classroom:

"After learning about learning styles and temperament styles I feel more sensitive to people who are different to me and understanding learning styles help me prepare better lessons for my students."

"I am now better able to provide lessons in more colorful and more visual instead of relying on the text to guide me."

"During my lab experience there was a time during a science lesson when I think I taught all four models of learning."

"Teachers need to be aware of their student's individual learning style to better suit the needs of their students."

"Sometimes as a teacher I have to go against my own learning style to accommodate the diverse learning styles in my classroom. I feel that I am better able to provide learning experiences for students if I am aware of their learning styles."

"I feel that it is necessary for an effective teacher to know students temperaments. By knowing their strengths, weaknesses, and motivators, teacher can plan activities that meet the needs of each student."

"By learning my own temperament and learning style helps me to better understand what areas in my teaching profession I need to improve upon as well as to help me learn how my students in the classroom learn."

"I think that balance is important in a classroom. I think I understand how to balance learning and temperament better. At least knowing this I will be able to not only achieve more but to achieve it more effectively to the benefit each and every one of my students."

Based upon information gathered from the pre-service teacher's comments, it appears that they are knowledgeable about adapting their teaching techniques to student's preferred learning and temperament styles.

Implications

According to Bryce (2002), there has been no relationship between temperament and learning styles. For the purpose of this study, pre-service teachers have seen the importance of teaching students in a science class the way they learn and how they want to learn. They have implemented more inquiry and discovery which is one of the National Education Science Standards- Content Standard A- Science as Inquiry. Most of all they have seen how teaching strategies that include learning styles and temperament styles have been effective in preparing students to learn. Additional research is needed to examine the relationship of learning styles and temperament styles. The researchers suggest the following:

- Methods courses in teacher education should encourage pre-service teachers to make use of learning styles and temperament styles;
- Staff development encompassing learning styles and temperament styles should be ongoing;
- With the recent introduction of the No Child Left Behind Act of 2002 the endorsement of the National Council of Teachers of Mathematics, 1989, and the National Science Teachers Association, 1992, science instruction is mandated on the national and state levels; thereby new and different strategies should focus on how teachers teach and students learn;
- Equip new teachers with further training on learning styles and temperament styles;
- More research conducted as to the correlation of learning styles and temperament styles;
- Conduct more formal research among teacher temperament styles and learning styles to see if temperament styles and learning styles correlate to increase student achievement.

Conclusion

In the future, teacher preparation programs would be best served by assessing their methods courses to include learning styles and temperament styles as part of the curriculum. Attitudes and assumptions that future teachers will understand how diverse student populations learn and behave cannot be automatically assumed. Unlike students in the past, students are exposed to greater information and content knowledge requirements that previously found, and with legislation such as the No Child Left Behind Act (2002), teachers are expected to meet or exceed the established goals.

Pre-service teachers, as well as new teachers need to acquire classroom skills that encompass the knowledge of learning styles and temperament styles. Teaching methods must be adaptable to student's different learning styles, and be able to differentiate their temperament styles. Pre-service teachers as they enter into the classroom must be determined to meet the needs of every child.

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Effects of Visual and Verbal Learning Styles on Learning

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Abstract

This article examined the visual and verbal learning styles of on campus learners as correlated with their academic progress. Learning styles models have been used regularly within the learning and teaching environment. This study used the *Index of Learning Styles* to survey the learners. Results indicated that the majority of the learners were Visual (n=15) and the remaining were categorized as Verbal (n=7). Academically, the Visual learners maintained higher academic success rates. This study reinforces the importance of meeting individual learners' learning styles in an educational setting as well as instructor awareness and curriculum enhancements possibilities.

Introduction

An emerging issue in education is the understanding and application of individual learning styles. Knowing the learning styles of the learners aids the designer or instructor to develop a curriculum to address various needs of the learners in a group or class. Kirby (1979) mentioned that the term learning style came into use when researchers began to look for ways to combine course presentation and materials to match the needs of each learner. Keefe (1979) indicated that learning style may be defined as the cognitive, affective, and physiological factors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment.

Claxton & Murrell (1987) have discussed learning styles extensively in their research. Presently a considerable amount of attention is being given to learning styles constructs that have paved the way to several learning style theories and instruments (Felder, 1993; Felder & Brent, 2005; Felder & Henriques, 1995; Hall, 2005; Heiman, 2006; Manochchri & Jon, 2006; Mupinga, Nora, & Yaw, 2006; Price, 2004; Sheridan & Steele-Dadzie, 2005; Silverman, 2006; Ware, & O'Donoghue, 2005.)

Methods

The pilot study explored the visual/verbal learning styles of on campus learners and their academic success. The purpose of the study was to determine whether the visual/verbal learning styles affect the learning of the learners. The two domains of learning styles for this study were Visual and Verbal.

The research question addressed in this study was “What are the differences between the visual /verbal learning styles that affect the learning (their grades) of undergraduate learners on campus?” The null hypothesis was that visual/verbal learning styles do not have an affect on the learning of learners. The alternative hypothesis was that the visual/verbal learning styles have an affect on the learning of learners.

Felder & Solomon (2007) explained that visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. They tend to find diagrams, sketches, schematics, photographs, flow charts or any other visual representation of course material that is primarily verbal very useful to learn. They use concept maps listing key points, enclosing them in boxed or circles, drawing lines between concepts to show connections. They color code notes with highlighter so that everything relating to one topic is the same color.

Felder & Solomon (2007) explained that verbal learners get more out of words--written and spoken explanations. They write summaries or outlines of course material in their own words, work in groups to have more effective learning experience, gain understanding of material by hearing classmates' explanations and learn even more when they do the explaining.

The sample for this study included those taking classes on campus at a major four-year southeastern university. Participants in this study were majoring in Education. A total of 22 individuals were surveyed. Montecinos and Neilsen (1997) indicated that teacher-preparation programs are predominantly attended by female students.

There were several limitations to this study. The small sample size representing the learners does not address all learners' learning style preferences. A larger sample size would be more appropriate for future research. This study does not reflect the participant's strengths in other learning styles. Different courses and different instructors might provide adequate assistance in other learning styles and aid the learners learn better and faster.

There were several assumptions associated with this study. It was assumed that visual learners learn better than the verbal learners. The sample used in this study represented a normal distribution. Equal homogeneity assumption is maintained according to the Levene's Test of Equality of Error Variances $F(1, 20) = 2.513, p = 0.129$. The sample was randomly and independently selected.

The information about this sample was obtained by contacting the instructor of a specific class at the university. The participants were eligible to participate in this study only if they are enrolled in on campus courses. The purpose of the study was explained

and surveys were provided to those who showed interest in learning about their learning styles.

Instrumentation

The *Index of Learning Styles* by Richard M. Felder, and Barbara A. Solomon, North Carolina State University, Raleigh, North Carolina was used to survey the learners (Felder & Solomon, 2006). The survey contains questions related to four domains – Active/Reflective, Sensitive/Intuitive, Sequential/Global and Visual/Verbal. However, for this study only the Visual/Verbal scores were taken into consideration to examine the visual and verbal learning styles of the participants. The paper pencil learning styles survey consisted of 44 questions with forced-choice items with two options – a and b. The participants were expected to select the appropriate answer for each question. The researcher designed a survey to collect demographic information from the learners. Demographic data consisted of gender, race, age and academic level.

Instrument Reliability/Validity

Felder et al. (2005) found estimates of reliability score from 0.56 to 0.77 using the Cronbach's Alpha statistical technique. In an unpublished study, Felder and Spurlin (2005) and Livesay, Dee, Felder, Hites, Nauman, and O'Neal (2002) examined the Index of Learning Styles survey responses of 584 learners at North Carolina State University, and found Cronbach's alpha coefficients to be in the range of 0.55 to 0.76.

Results

There were seven verbal and 15 visual learners in this group. The sample consisted of 1 male (4.5%), and 21 females (95.45%) All participants were Caucasian (100%), between the age of 20 – 25 years and were seniors. Statistical Program for Social Science 13.0 (SPSS, 2004) software has been used to analyze the data. To address the research question, data were analyzed using an Independent Samples T-Test with statistical significance set at 0.05. The independent variable was the learning style (visual/verbal) and the dependent variable was the grade.

The dependent variable is operationalized by the points achieved (score) in the course. It was found that the learners' grades have significant statistical difference between visual and verbal learners, $F(1,20) = 40.151, p < 0.001$. When the means are compared, the visual learners ($M=164.267, SD=14.71$) achieved higher scores than the verbal learners ($M=115.714, SD=20.70$). The effect size assessed by partial Eta square was 0.668 which was large.

Conclusion

Regardless of learners' background of education, teachers or instructors have the enormous task of meeting individual learners' learning styles in the educational setting. It is the nature of learners to learn in a specific way depending on the learning style. The results of this study yielded a statistically significant difference between the visual and verbal learners. The majority were visual learners which has implications in the classroom and learning environment. They learn better with pictures, diagrams, flow charts, time lines, films and demonstrations. This information should be considered important in design and development of courses, instructional or training programs. The differences of learning styles are affecting the learning and hence if addressed appropriately, there will be an enormous improvement in the learning and that more learning will occur substantially faster.

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The Relationship Between Cognitive Learning Styles and Distance Education

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Abstract

As the number of distance education programs increases, there is a greater need for understanding the impact of individual learning styles on student achievement in these programs. This article addresses the relationship between learning styles and distance education. It provides a description of individual learning styles using the Gregorc Style Delineator. Recommendations for practice are also addressed.

Introduction

The prevalence of distance education at 2-year and 4-year higher education institutions in the United States is steadily increasing (Snow, Farris, & Levin, 1999). The rise in popularity of distance education has increased the potential for many nontraditional and traditional students to participate in learning activities. One of the growing concerns regarding distance education is the ability of the student to retain the knowledge that is gained during the learning process. In order to address this concern, it is imperative to consider the learning styles of distance education students and their subsequent relation to the students learning and retention in distance education programs.

Learning Styles

In an effort to define learning styles in a cognitive context Gregorc (1979) stated that "Learning style consists of distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment. It also gives clues as to how a person's mind operates" (p. 234).

There are four primary domains of learning to be considered when addressing an individual's learning style. These domains are the cognitive domain, affective domain, psychomotor domain, and physiological domain. Bloom (1956) describes the cognitive domain as the acquisition of knowledge and ability to recall that knowledge for application. The affective domain addresses how individuals receive, respond to, and ultimately internalize stimulus emotionally (Bloom et al., 1973). The psychomotor domain uses physical activity as a way to gain knowledge and skills (Simpson, 1972). The physiological domain addresses how a learner's environment, and the many elements thereof, impacts their ability to learn (Dunn & Dunn, 1978).

There are many different assessments of learning styles available. The variety of assessments available leads to a variety of descriptions for the learning styles which it is measuring. For the purpose of this research paper, it will focus on the four dominant learning styles that are defined in the *Gregorc Style Delineator* (Gregorc, 1982). The *Gregorc Style Delineator* is a widely used assessment of cognitive learning styles (O'Brien, 1994). Additionally, there are studies supporting the validity and reliability of the instrument (Joniak & Isaksen, 1988; O'Brien, 1990).

The first learning style defined by Gregorc (1982) is the Concrete Sequential (CS) learner. The CS learner can be summed up as a realist. They view reality through the concrete world of the physical senses and prefer sequential steps to arrive at solutions to problems. Their thinking processes are very methodical and result in solutions that have been validated by personal proof or subject experts. Slightly resistive to change, the CS learner performs best in a learning environment which is ordered and stable.

Abstract Sequential (AS) is the second learning style defined by Gregorc (1982). The AS learner thinks in a logical and rational manner much like the CS learner does. However, the AS learner better associates abstract information that corresponds to concrete reality than the CS learner does. The AS learner is a logical thinker who requires a stimulating learning environment that is free of authoritative features which would restrict their freedom to learn.

The Abstract Random (AR) learner views the world primarily through their sense of feelings and emotions. These feelings and emotions drive their approach to change and often determine their level of interest in a topic or learning situation. An idealist by nature, the AR learner requires emotional and physical freedom in their environment to enhance their learning. AR learners live for today and often possess a colorful personality. They also place a great amount of emphasis on relationships (Gregorc, 1982).

The Concrete Random (CR) learner lives in a world that is influenced by the physical world and their sense of intuition. The physical world often serves as a starting point for their learning. Once started, CR learners will then rely on their intuition to guide their learning. CR persons are intuitive and independent learners. They learn best in a learning environment that has a high amount of stimulus and is free from learning restrictions. CR learners possess a good balance of realist and idealist qualities which enable them to cope well with changes to the learning environment (Gregorc, 1982).

Distance vs. On-Site Education

Is there a difference in learning outcomes between students enrolled in courses in the traditional on-site learning environment and those enrolled in distance education

courses? Do differences in learning styles have an impact on student performance in distance education? The studies described below were conducted to address these important factors.

The first study examined the differences in outcomes between two groups of students enrolled in the same course. One group attended a class on campus and the other participated in a distance education offering of the same course. Both groups received the same lessons, used the same books, and were given the same assignments (Aragon, Johnson, & Shaik, 2002).

The major differences between the two groups in the study revolved around interactions and discussions. While the traditional group participated in open classroom discussion, the discussions of the distance education participants occurred via email and real-time chat during a one-hour synchronous broadcast over the internet. Group work was conducted by both groups and there were no differences in the activities required between the two groups of students (Aragon, Johnson, & Shaik, 2002).

The results of the study indicate that there was no significant difference in learning outcomes between the two groups of students. The study did indicate that the students in the distance education course were significantly more reflective. This was attributed to their abilities to work more independently and at their own pace (Aragon, Johnson, & Shaik, 2002).

Simpson and Du (2004), examined the effects of learning styles on class participation and student enjoyment in distance learning. In this study, all of the participants were enrolled in a distance education course for the first time. Each participant's learning style was assessed at the beginning of the course. Their class participation and student enjoyment were measured at the end of the course.

The outcomes of Simpson and Du's (2004) study revealed a significant relationship between student learning style and their enjoyment level of the course. Learner's who prefer an active environment to reinforce the material received the most enjoyment out of the course. Learner's who were more reflective in nature enjoyed it the least. The study also showed that learning style was significant in explaining the level of student participation. Concrete learner's tended to be more active in the course than their abstract counterparts.

In a study conducted by Ross and Schulz (1999), the authors discovered that AR learners may not perform well in courses which use computer aided instruction. This study identified that the AR learner performed poorly compared to their counterparts in a Cardiopulmonary Resuscitation (CPR) certification course. It also revealed that

they spent less time with the program, used less of the instructional aid and interacted with the computer than their counterparts.

Implications for Practice

Some facet of each of the previously defined learning styles can be found in the results of the studies discussed above. This would indicate that all students have some potential for success in distance education. The key to success is not only in the learner, but also in the design of the course.

The design and implementation of distance education courses can be a major obstacle. The courses should require the same amount of work as a traditional course offering. This means that the instructor must design assignments, means of communication with students, and grading policies. Often times, these result in an increase in the amount of time spent on a course. A brief in class conversation can take much longer using electronic means of communication such as chat and e-mail (Howland & Moore, 2002). Course assignments must be written and posted which requires some level of technical proficiency.

Distance education courses must also be designed to keep the student engaged. One flaw of distance education is the excessive freedom students have to procrastinate in completing assignments (Howland & Moore, 2002). This may cause the student to fall behind in their coursework and subsequently reduce their learning outcomes and level of class enjoyment.

Technical difficulties can also be a hindrance in the administration of distance education. These technical difficulties may arise from the failure of equipment that is critical to the delivery of the material. Technical difficulties may also be personnel related. The instructor and all those involved in the administration of the course must be properly trained on the use of the equipment and methods that are necessary for conducting the course.

Conclusion

Ross and Schulz (1999) provide the following five tips for the effective and responsible use of technology in education. These guidelines will help both the student and the instructor maximize the effectiveness of instruction and level of retention that is achieved in any distance education program.

1. All computer aided instruction should be closely monitored. Take special care to ensure that outcomes are measured periodically and students should be given tasks to help keep them engaged.

2. Ask for student feedback on their learning experiences. Educators should also determine the learning styles of their students to determine the best approach for teaching the material.
3. Provide opportunities for group work to those students who may be reluctant to work alone via distance education. This may be especially helpful for the AR learners.
4. Be cautious of sweeping curriculum changes which may convert entire programs into distance education courses as this may alienate certain groups of learners.
5. Utilize multiple teaching strategies to ensure that students with differing learning styles are not alienated. An alternate method of delivery may be appropriate to prevent this from occurring.

In conclusion, the importance of understanding students learning styles is as applicable in distance education as it is in traditional classroom settings. By successfully assessing the student's learning style and presenting the material in a manner that matches their needs, both the student and the educator will strive for the desired outcomes.

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Learning Styles and Memory

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Abstract

The purpose of this article is to examine the relationship between learning styles and memory. Two learning styles were addressed in order to increase the understanding of learning styles and how they are applied to the individual. Specifically, memory phases and layers of memory will also be discussed. In conclusion, an increased understanding of the relationship between learning styles and memory seems to help the learner gain a better understanding of how to maximize benefits for the preferred learning style and how to retain the information in long-term memory.

Introduction

Learning styles, as identified in the Perpetual Learning Styles Theory and memory, as identified in the Memletics Accelerated Learning, will be overviewed. Factors involving information being retained into memory will then be discussed. This article will explain how the relationship between learning styles and memory can help the learner maximize his or her learning potential.

Learning Styles

The Perceptual Learning Styles Theory lists seven different styles. They are print, aural, interactive, visual, haptic, kinesthetic, and olfactory (Institute for Learning Styles Research, 2003). This theory says that most of what we learn comes from our five senses. The Perceptual Learning Style Theory defines the seven learning styles as follows:

The print learning style individual prefers to see the written word (Institute for Learning Styles Research, 2003). They like taking notes, reading books, and seeing the written word, either on a chalk board or thru a media presentation such as Microsoft Powerpoint.

The aural learner refers to listening (Institute for Learning Styles Research, 2003). The aural learner is a very good listener and likes to talk. The aural learner really likes listening to music and can learn music through association of a song and memorized phrase. The aural learner in actuality learns well through lectures and can often repeat what the speaker has said almost perfectly.

The interactive learner refers to verbalization (Institute for Learning Styles Research, 2003). An interactive learner often prefers to discuss things with others and finds small group discussions very informative and stimulating. The interactive learner really enjoys questions and answer sessions. You will often find the interactive learner humming or talking to their selves because they cannot stay quiet for great lengths of time. The interactive learner just likes hearing their own voice.

The visual learner refers to seeing visual depictions such as pictures and graphs (Institute for Learning Styles Research, 2003). The visual learner has a vivid imagination and therefore prefers visual arts and media. The visual learner's imagination is so great that they can conjure up images of a form by seeing it in their mind. The visual learner constantly needs something to watch otherwise they will get bored. The visual learner is very often quiet and doesn't feel the need to talk at any great length of time. The visual learner greatly benefits from seeing and watching demonstrations and really likes visual stimuli; such as pictures, slides, and graphs.

The haptic learners refer to the sense of touch or grasp (Institute for Learning Styles Research, 2003). The haptic learner loves to piece things together and will be very successful with tasks that require him/her to manipulate something. The haptic learner enjoys doing artwork, tracing words and pictures and will often be found doodling. The haptic learner loves a hand on approach and will take an object apart just to see how it works. The haptic learners are always seen tinkering around with various items. Once they have taken the object apart, they now know how it works and can tell you what they have learned through this process.

The kinesthetic learner refers to whole body movement (Institute for Learning Styles Research, 2003). The kinesthetic learner will use movement to help their concentration. You will sometimes find this learner fidgeting or just finding some reason to move around because they always want to be doing something. This learner learns by doing and having direct involvement. They are not very attentive if they have to listen to a visual or auditory presentation. They are often very poor listeners.

The kinesthetic learner gestures when they are speaking to you. They really respond well to music by physical response activities because this learner learns better when they are able to move during the learning process. The kinesthetic learner loves to think out issues, ideas and problems while they are exercising and would rather run or walk if something is bothering them (Institute for Learning Styles Research, 2003).

The olfactory learner refers to sense of smell and taste (Institute for Learning Styles Research, 2003). The olfactory learner learns best through their sense of smell

and their taste. They feel that smells add to their learning and often connect a particular smell with a specific past memory. Smells have a very special meaning to them so therefore they place a special significance on them. The olfactory learner is often able to identify smells quickly.

Learning Styles as Related to Memory

The Memletics Accelerated Learning Manual (Advanogy.com, 2003) lists and describes seven different learning styles that are similar to the Perceptual Learning Style. The difference is the way that they are described in relation to how the brain works (Advanogy.com, 2003). These styles are as follows: Visual learners refer using pictures, images, and spatial understanding (Advanogy.com, 2003). This learner uses the occipital lobes at the back of their brain that manages the visual sense. Both the occipital and parietal lobes manage spatial orientation. Aural learners prefer to use music and sound. Aural learners use the temporal lobes that handle aural content. The right temporal lobe is especially important for music. Verbal learners prefer using words, both in speech and writing (Advanogy.com, 2003). This learner uses the temporal and frontal lobes, especially two specialized areas called Broca's and Wernicke's areas (in the left hemisphere of these two lobes).

Physical learners prefer using their body, hands and sense of touch (Advanogy.com, 2003). This learner uses the cerebellum and the motor cortex (at the back of the frontal lobe) that handles much of our physical movement. Logical learners prefer using logic, reasoning and systems (Advanogy.com, 2003). This learner uses the parietal lobes, especially the left side that drives our logical thinking. Social learners prefer to learn in groups or with other people (Advanogy.com, 2003). This learner uses the frontal and temporal lobes that handle much of our social activities. The limbic system also influences both the social and solitary styles (Advanogy.com, 2003). The limbic system has a lot to do with emotions, moods and aggression. Solitary learners prefer to work alone and use self-study (Advanogy.com, 2003). This learner uses the frontal and parietal lobes, and the limbic system is also active with this style (Advanogy.com, 2003).

Function of Memory

To better understand how we can retain the learned information, it is important to know how our memory works. Sprenger (2003) revealed from various sources that there are three phases of memory, the storage phase, the retrieval phase and the learning/encoding phase. Problems sometimes happen at any of these phases such as sleep deprivation, lack of concentration, or forgetting. She goes further by explaining

that there are three processes of memory, sensory memory, short-term memory, and long-term memory.

The sensory memory is where the learning styles come in. The sensory memory is how the information is entered into our brain which is through our senses. Our senses are how we perceive the world through association of sights, sounds, touches, smells and tastes (Sprenger, 2003). The immediate memory is a process where the sensory memory is stored in the brain, also known as conscious memory. This process lets us hold up to at least four bits of information for a short period of time. Immediate memory holds the information while new information is being added (Sprenger, 2003).

The short-term memory is between the immediate and the long-term memory (Sprenger, 2003). The short-term memory is where the new and old information get together. Short-term memory usually stores the first word of a sentence so that you can understand the general idea until you get to the end. In other words it takes short-hand for you. An example of this would be if you were given a problem to solve and you had a few clues to use, the short-term memory would hold the clues until you got more information to solve the problem. A classic example of short-term memory usage is when students use their short-term memory to study for tests. The student will often study and take in a lot of information the night before an exam then use it for their exams the next day. This process is not recommended because the information will not be stored in their long-term memories. Sprenger further indicated that there are four factors that affect immediate memory: interest, intent, understanding and prior knowledge. If interest, understanding and prior knowledge are not there, then the intent to remember can make a difference.

Long-term memory can be separated into two types: implicit memory which is memory that occurs without a conscious effort and explicit memory which is the opposite in which it occurs with a conscious effort. Explicit memory is our memory that holds facts and events (Sprenger, 2003).

Explicit memory is broken down into two categories, the first is semantic. Semantic is information related for factual information (Sprenger, 2003). This information can be problematic to hold on to due to the fact that unless the information is related to something the learner can understand the information will not be retained. The second memory under explicit memory is episodic memory. Episodic memory is when we remember a place that we have been and we recall what we learned there (Sprenger, 2003).

Implicit memory is remembering information that is learned subconsciously (Sprenger, 2003). These memories are brought into the surface by conditional

responses, emotional, and procedural memories. Conditional responses are brought about by a sound or a phrase. Procedural memories are memories that are brought on by movement such as hand movement to help the person to recall. Emotional memories are stimulated by experiencing emotions (Sprenger, 2003). The theory of emotional memories is if the person can feel it then they will be able to remember it.

In order to achieve maximum learning proficiency the body and mind need to be in a good state. Cells can be categorized into three layers which are: cell state, physical state, and mental state. The cell state is where the basic nutrients such as water and oxygen reside. The physical state is the layer where health issues such as sleep and fitness reside. And the last layer is mental state; consisting of attention, concentration, positive mental attitude, and goals (Advanogy.com, 2003).

Conclusion

Kratzig and Arbuthnott (2003) concluded there was insufficient evidence that the Learning Styles alone provides a total basis to retain learned information. They suggested that helping individuals learn effective memory strategies across all stimulus modalities and contexts would be beneficial. They also discovered that what stimulated the memory retention depended upon the interest of the information, method used to deliver the information and the motivation of the speakers.

The Perceptual Learning Style Theory and the Memletics Learning Styles theories reveals individual learning styles and how important it is to know what they are in addition knowing how memory works within the learning process. Linking memory and learning styles together depends upon several factors. These factors are background knowledge, interest level, physical state, and emotional state. It is important to know where the learner is in regards to these factors to achieve the ultimate learning experience.

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Evaluation of Learning Styles and Instructional Methods in the NROTC Naval Operations and Seamanship Course

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Introduction

A mismatch exists between common learning styles and traditional post-secondary instructional methods. Because of this mismatch, students can become bored with course materials, can perform poorly on examinations, and can be discouraged with the curriculum (Felder & Silverman, 1988). Though there could be a tendency to cater to the individual learning styles, according to Felder and Spurlin (2005), a teacher should not accommodate certain learning style preferences because, for students to function as professionals, they need skills associated with both categories with a given learning style dimension. By assessing the learning style of a classroom, the instructor can provide effective instructional methods that support each of the different learning styles.

To illustrate the effectiveness of instructional methods that support learning style preferences, Felder (1995) investigated 123 chemical engineering students who took five successive courses with the researcher. The purpose of Felder's study was to examine the performance of an experimental group who received novel instructional methods and a comparison group who received the traditional instructional methods. Instructional methods used included inductive presentation course material, which moved from facts and familiar phenomena to theories and mathematical models, and use of realistic examples of engineering processes to illustrate basic principles. The participants were involved with laboratory activities, field experiences, and guest speakers, who spoke about how engineering concepts applied to the real world setting. The researcher/instructor used active learning with cooperative (team-based) groups, reduced lecturing time, asked open-ended questions, and required problem formulation homework exercises.

Felder (1995) found that the final grades in the introductory course were skewed toward the higher grades. The number of failures was equivalent to previous courses, but 56% of the participants earned a B average or higher. Six weeks into the introductory course, the researcher/instructor gave the option to complete homework individually instead of in the required study groups. Of the 115 participants, only three chose to work independently. Of the 67 participants who were seniors, 92% of them reported the experimental instructional methods were more effective than the other chemical engineering courses that were taught with traditional methods. Four years

after the introductory course, 79% of the participants had graduated or were still enrolled in chemical engineering.

The purpose of this study was to assess the following research questions: (1) What is the predominant learning style for the students in the NROTC Naval Operations and Seamanship; (2) What are the instructor's primary instructional methods?; and (3) Are the instructor's primary instructional methods congruent with the predominant learning style of the students?

Evaluation Plan

Students. The students who were involved in this teacher evaluation included seven white males. These students were undergraduates at the Auburn University Navy Reserve Officers Training Corps (NROTC) Program. In their senior year, they began their course of study directly after high school graduation. The students ranged in age from 21 to 22 years old. These students had not completed a learning styles inventory prior to this evaluation.

Instructor. The instructor enlisted in the US Navy over 16 years ago. His professional experiences include operation and maintenance of the electrical and electrical generating equipment for the submarine, anti-submarine warfare Officer, and engineering training. Currently, the instructor serves as an Assistant Professor of Naval Science. His educational background includes a bachelor's and master's degree in Adult Education.

Course. Naval Operations and Seamanship is required course within the NROTC curriculum for senior-level students. The course is a continued study of relative motion, formation tactics, and ship employment. Other topics include an introduction to naval operations and operations analysis, ship behavior and characteristics in maneuvering, applied aspects of ship handling, afloat communication, naval command and control, naval warfare areas, and a review and analysis of case studies involving moral, ethical, and leadership issues.

Measure. Richard Felder, Professor of Chemical Engineering at North Carolina State University, and Linda Soloman, Coordinator of Advising, First Year College, at North Carolina State University, developed a learning style model to differentiate the learning styles among engineering students and to assist with instructional approaches to address those learning styles in the classroom (Felder & Spurlin, 2005). The model has four dimensions (Felder & Silverman, 1988; Litzinger, Lee, Wise, & Felder, 2005):

- *Active* processing (prefer active student participation in groups) or *reflective* processing (prefer passive student participation by themselves or with one familiar partner).
- *Sensing* perception (prefer concrete, practical content) or *intuitive* perception (prefer abstract, conceptual content).
- *Visual* input (prefer visual presentation) or *verbal* input (prefer written and spoken presentation).
- *Sequential* understanding (prefer linear thinking) or *global* understanding (prefer holistic thinking).

While the combination of these dimensions is unique to the Felder-Soloman Model, each dimension corresponds in other learning style models. The active/reflective dimension complements the Kolb's Learning Style Model. The sensing/intuitive dimension was directly taken from Myers-Briggs Type Indicator (MBTI), which was based on the theories of Carl Jung. This dimension is analogous to the concrete/abstract dimension from Kolb's Learning Style Model. The active/reflective and visual/verbal dimensions have similarities with visual-auditory-kinesthetic modality theory. Furthermore, visual/verbal dimension derives from information processing theory. The sequential/global dimension parallels left-brain and right-brain dominance theories (Felder & Spurlin, 2005; Larkin & Budny, 2005).

The Index of Learning Styles (ILS) has 44 items. The prompts present various situations and the respondent selects one of the dichotomous options that best describes him or her. The initial version was created in 1991. The instrument was revised in 1994 after factor analysis. The paper-pencil version was posted on the internet in 1996. The online version was posted on the internet in 1997. The ILS is available without fees for educational and research purposes (Felder & Spurlin, 2005).

There are two principal applications for the ILS. First, instructors can assess learning styles of his or her students and use the assessment results to guide instructional design. Thus, all learning styles can be addressed during instruction. Second, for individuals, the ILS can give them insight regarding their strengths and weakness and facilitate the learning process (Felder & Spurlin, 2005).

Each dimension consists of two categories, and each category has a score ranging from 1 to 11. Scores ranging from 1 to 3 indicate mild or well balanced between the two categories. For scores between 5 and 7, a moderate preference is indicated, which means favoritism for one of the two categories. Scores between 9 and 11 indicate a very strong preference, meaning difficulty with learning where the environment does not support that category (Felder & Spurlin, 2005; NC State University, n.d.).

The test-retest reliability for the ILS ranges from .73 to .87 after 4 weeks (Felder & Spurlin, 2005) and from .56 to .77 after 10 weeks (Litzinger et al., 2005). Internal consistency of the four dimensions ranged from .51 to .62 for active/reflective, from .65 to .76 for sensing/intuitive, from .56 to .69 for visual verbal, and from .41 to .54 for sequential/global. A factor analysis was conducted with the ILS revealed active/reflective, sensing/intuitive, and visual/verbal to be orthogonal. Sequential/global and sensing/intuitive dimensions were found to be associated (Felder & Spurlin). Discriminant validity was determined by conducting a bivariate correlation between the four dimensions. Correlations ranged from -.09 to .32, which indicated weak interrelationships among the dimensions (Zywno, 2003).

Procedures. An Index of Learning Styles Behavioral Checklist was developed using the National Survey of Science and Mathematics Education (Westat, 2000) and the Mathematics Teacher Questionnaire: Main Survey (TIMSS Study Center, 1998). Based on a review of literature three domains were created: Instruction, Independent Student Activity, and Student Interactions. Using the literature available regarding the Felder-Soloman Learning Style Model (Felder & Silverman, 1988; Felder & Soloman, n.d.; Larkin & Budny, 2005), each behavior was coded according to its association with each category. The instructor reviewed the Checklist prior to the first observation.

Participants were asked by the instructor to complete the ILS at the following URL address: <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>. After completing the 44-item inventory, the participants were instructed to print the results summary and submit it to the instructor on the first classroom observation. The results were coding based on a strong (9 to 11), moderate (5 to 7), and mild (1 to 3) relationship with each of the eight categories.

The researcher observed the same class on two consecutive days. During the class period, the researcher indicated the number of times a specific behavior occurred on the Checklist. After the end of the observation, the frequencies were summed. Test-retest reliability coefficients were conducted to determine consistency of behavior frequencies between first and second observations. For instructional methods, the reliability coefficient was very good (.97). A reliability coefficient could not be assessed for independent student activity because there was not any independent activity during the second observation. The reliability coefficient was student interactions was .00 due to the format difference between observation 1, hands-on lab activity, and observation 2, lecture of content.

Evaluation Results

Pre-Dominant Learning Style. Descriptives were analyzed to determine the pre-dominant categories for each of the four dimensions. Table 1 displays the frequencies, means, and standard deviations by category. This group of students tended to be active, sensing, visual, and sequential learners. Thus, this group of students prefers concrete, hands-on learning experiences in pairs or small groups, and they prefer visual presentations of material in a logically and sequential order. The active and sequential categories were considered as mild, and sensing and visual were considered as moderate, which indicated moderate preference toward these categories during learning experiences.

Table 1

Frequencies, Means, and Standard Deviations by Category

Scale	<i>n</i>	%	<i>M</i>	<i>SD</i>
Active	7	100.00%	3.57	2.23
Reflective	0	0.00%	0.00	0.00
Sensing	6	85.71%	6.67	2.66
Intuitive	1	14.29%	1.00	--
Visual	6	85.71%	5.00	2.53
Verbal	1	14.29%	5.00	--
Sequential	5	71.43%	3.80	3.03
Global	2	28.57%	1.00	0.00

Primary Instructional Methods. A descriptive frequency count assessed the number of observed behaviors by time. Tables 2, 3, and 4 display the frequency behavioral count for each domain by time. Informal assessments (e.g., knowledge questions) accounted for 40% of the observed instructional methods. These quantified behaviors do not include other questioning comments, such as “make sense.” “Do you agree,” and “okay.” The instructor applied the concepts to the real-world experience (e.g., aboard a ship) over 20% of the observed behaviors. During the first observation, the instructor allowed time for independent student activities. The primary source of activity was scenarios in the students’ workbooks. The students tended to work in pairs for checking answers, asking questions, and reviewing assigned homework during the guided and independent practice sessions. The majority (51.52%) of student interactions during the first observation was in pairs. Due to the format of the second observation, the student

interactions were divided among pairs, small groups, and large groups; however, the observation mean revealed pair groupings accounted for over 48% of the student interactions.

Table 2

Frequency Count for Independent Student Activity by Time

Behavior	<u>Observation 1</u>		<u>Observation 2</u>		<u>Mean</u>	
	<i>n</i>	%	<i>N</i>	%	<i>n</i>	%
Answered textbook, workbook, or worksheet questions.	4	44.45%	0		4	44.45%
Completed hands-on/laboratory activities.	3	33.33%	0		3	33.33%
Followed specific instructions in an activity.	2	22.22%	0		2	22.22%
Total	9	100.00%	0		9	100.00%

Table 3

Frequency Count for Student Interactions by Time

Behavior	<u>Observation 1</u>		<u>Observation 2</u>		<u>Mean</u>	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Individual	9	27.27%	0	0.00%	4.5	23.08%
Pairs	17	51.52%	2	33.33%	9.5	48.72%
Small Groups	5	15.15%	2	33.33%	3.5	17.95%
Whole Class	2	6.06%	2	33.33%	2	10.25%
Total	33	100.00%	6	100.00%	19.5	100.00%

Table 4

Frequency Count for Instruction by Time

Behavior	<u>Observation 1</u>		<u>Observation 2</u>		<u>Mean</u>	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Conducted a pre-assessment (e.g., factual review).	8	6.96%	4	2.58%	6	4.44%
Provided goal or objective of lesson.	2	1.74%	2	1.29%	2	1.48%
Presented new concepts lecture-style.	1	0.87%	1	0.64%	1	0.74%
Provided computer-assisted instruction.	5	4.35%	2	1.29%	3.5	2.59%
Provided graphic organizer.	4	3.48%	20	12.90%	12	8.89%
Provided skeleton outline or powerpoint handouts.	1	0.87%	1	0.64%	1	0.74%
Conducted a demonstration.	20	17.39%	13	8.39%	16.5	12.23%
Applied concepts to real-world experience.	17	14.78%	38	24.52%	27.5	20.37%
Used manipulatives.	3	2.61%	3	1.94%	3	2.22%
Used assessments embedded in class activities (e.g. informal assessments).	40	34.78%	68	43.87%	54	40.00%
Provided teacher-guided student practice.	14	12.17%	3	1.94%	8.5	6.30%
Total	115	100.00%	155	100.00%	135	100.00%

Congruence between Instructional Methods and Learning Style. A chi-square non-parametric analysis (Siegel, 1956) was conducted to determine if the observed behaviors of the instructors were different from the distribution of learning styles in the classroom. While the literature suggests supporting all learning styles during instruction, particular fields, such as engineering, are dominated with certain learning styles, which was the case with this group of students. The observed behaviors for instruction, independent student activity, and student interactions were summed by category according to the code sheet and averaged across observations. The expected frequency was based on the percentage of students in each category and the number of observed instructional behaviors within each dimension.

The frequency of observed instructional behaviors was statistically significantly different from the students' learning style for the first observation with the active/reflective dimension, $\chi^2 = 6.04, p < .05$; however, with the second observation, $\chi^2 = 0.03, p > .05$, and the observation mean, $\chi^2 = 1.71, p > .05$, there was not a statistically significant difference for the active/reflective dimension. For sensing/intuitive dimension, there was a statistically significant difference between the expected frequency based on the students' learning style and the frequency of instructional behaviors for all observations, $\chi^2 = 10.45, p < .05$ (observation 1), $\chi^2 = 11.93, p < .05$ (observation 2), and $\chi^2 = 11.19, p < .05$ (observation mean). One explanation for these significant results could be the small sample size ($n = 7$).

With the visual/verbal dimension, there was not a statistically significant difference between the observed and expected frequency of learning styles across both observations, $\chi^2 = 0.99, p > .05$ (observation 1), $\chi^2 = 3.02, p > .05$ (observation 2), and $\chi^2 = 0.98, p > .05$ (observation mean). For the last dimension of sequential/global, there was not a statistically significant difference between the instructional behaviors and the expected frequency based on the students' learning styles for the first observation, $\chi^2 = 1.64, p > .05$ (observation 1); however, there was a statistically significant difference for the second observation, $\chi^2 = 32.18, p < .05$, and the observation mean, $\chi^2 = 12.92, p < .05$. One explanation for these significant results was the instructional format of the two observations (application activity and lecture style).

These results suggested that the instructor's instructional methods are congruent with the students' learning styles for the active/reflective, visual/verbal, and sequential/global dimensions. The sensing/intuitive dimension had statistically significant results across both observations, meaning the instructor needs to add more open-ended and abstract scenarios into his instructional methods to support the intuitive learning style, but these results may be skewed based on the small sample size.

Conclusions

The findings of this teacher evaluation revealed the NROTC students were categorized pre-dominantly as active, sensing, visual, and sequential learners, which support the findings of Felder and Silverman (1988). The instructor used a variety of instructional methods during the two observations, but his primary methods were informal assessments and real-world applications of the course concepts. A limitation of the evaluation was the small size ($n = 7$); however, the chi-square results indicated a congruent relationship between the students' learning styles and the instructor's instructional behaviors. Future research could assess the congruence between learning styles and instructional methods across multiple instructors.

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