Title: Experiential-learning in Education and Neuroscience

Abstract

The American model of education is failing. But while everyone looks to place the blame somewhere, our children only fall farther behind. While I as a neuroscientist am foremost concerned with the brain, I am also always actively considering the broader, practical impact of my work. My own interest in teaching and education has led me to conclude the teachers are themselves also neuroscientists, and of neuroscientists are the most applied cognitive neuroscientists because of how everything that they do is related to positively shaping the brain. However, while teachers hold this distinction, they are trained to teach, but not about know about the brain. Thus, in neuroscience, the broadest, most impactful practice would be to work with teachers to help answer their questions about the brain and develop teaching practices supported by neuroscientific research. Here I present a potential solution to the problems of teachers' knowledge about the brain and America's educational shortcomings, one that at no cost to school districts offers potentially innovative approaches to teaching practices. Here, I propose the implementation of the "service-learning" model of education in graduate neuroscience and psychology courses to work with teachers to answer their questions related to the brain and development and develop novel, research-based teaching practices. While the future of the United States is at stake, instead of actively tanking our educational system, we could attempt to improve it by assessing neuroscience literacy and interest in adapting neuroscience principles into practice, with the hope that we can fundamentally alter education and later benefit millions of students and teachers across the US.

Narrative of purpose

While the United States of America (US) has long held the belief that it is better than everyone at everything, recently these beliefs have begun to look a lot more like wishes. In particular, the education rankings of the US have been plummeting, in fact they have fallen so far as to be considered "average" in the world (Johnson, 2010). In the US, "average" is considered failure, but rather than addressing the underlying causes, the US has thrown everything at the symptoms, looking for a quick fix. While, school districts seem to always be in search of the "next thing" to reverse the current trend, whether through technology (e.g. iPad) or through using different models of education (e.g. the "Finnish model") schools are constantly scrambling, only to fall farther behind. However, with education budgets gouged and teacher benefits and salaries slashed, the downward trends in the rankings do not appear to be changing anytime soon. The state and national governments (read: stingy anti-intellectualists) looking to place the blame, have generally been turned to the estimated 3.6 million teachers and the approximately 70 million students across the US, but rather than focusing on them, we actually turn our focus on the outdated teaching practices being used by mis- and undereducated teachers.

A teachers' entire job revolves around one goal, to help positively grow and cultivate a child's developing brain. Although when thinking about brain development and teaching, one may think about the most obvious level, that of cognitive/intellectual development, but brain development additionally includes development at both social-emotional and biological levels. While the goal of brain development is not directly articulated, as a quick review of the literature dictates teaching goals as including: facilitating learning, providing a role model, preparing

students for jobs/careers, and fostering student development and growth, these goals are inherently about the brain because our whole being comes from the workings of the brain. While teaching efficacy is almost exclusively evaluated only for the proficiency of development at the cognitive level, teachers are generally encouraged to help students develop inspiration, and pride in their learning process, and also help students to become valuable and positive members of a community. These broad proficiencies that are required of teachers, appear to ask them to be "jacks of all trades." However, again if we recognize the importance of the brain in our thoughts and behaviors, we can look to proficiency in just one area, neuroscience that can help teachers to meet many diverse goals.

Generally neuroscientists are faced with the question of, "so what," what does your work mean to the broader population? Often relevance of work is tied to clinical issues or practical issues. So summarizing teachers efforts as simply "brain development," one can view teachers as the most practically relevant cognitive neuroscientists. Through this view, we should expect that teachers receive proficient training in cognitive neuroscience, allowing them to understand the brain and what is happening when students are learning, and why students with certain disabilities (dyslexia, ADHD, Autism, traumatic brain injury) behave or perform a certain way. With this understanding, teachers can then develop the best teaching practices to facilitate teaching goals and outcomes. However, this does not appear to be the case. Howard-Jones and colleagues (2009) present a study of neuroscience literacy of teachers in training in England. Results indicated that trainees' ideas about the brain reflected misconceptions in public circulation and notions promoted by popular brain-based educational programs. Most of the trainee teachers in the survey did not accept, or were unsure, about whether mental activity derives from biological brain function. Trainee teachers place equal importance on home environment and education as determinants of educational outcome, with genetics a significant but smaller influence than either. The authors conclude that in the absence of formal training, trainee teachers acquire their own ideas about brain function, which may be detrimental to their practice as teachers (Howard-Jones, Franey, Mashmoushi, & Lioa, 2009).

The following project bridges the relationship between education and neuroscience and revolves around three subjects; one, that neuroscience is important to education, two, that experience and reflection are essential to the learning process and three, that service-learning can serve to tie the first two subjects together. No matter, what you call "service-learning" (or experiential-learning as I choose to) there appears to be endless permutations of 1) service and 2) learning synonyms with different combinations of the 1) the relationship between the two domains and 2) the focus on two domains, education and community. In my own approach, I view the education component as the primary purpose, but the education is dependent on the experience (and thus the community interaction). However, I view any benefit for the community as merely a consequence of the quality of the educational experience. Inspired by psychologists (e.g. Vygotsky; Hua Liu & Matthews, 2005), philosophers (e.g. Dewey; Kolb, Boyatzis, & Mainemelis, 2000), and neuroscientists (Immordino-Yang & Damasio, 2007), learning is best accomplished through experiences and is actively constructed rather than mechanically acquired. While the classroom offers the opportunities to be exposed to principles and concepts to later be reflected upon, the world offers the experiences and the opportunities to explore and form one's own understanding of the subject matter. Baker and colleagues (1997) note that the transformation of experience into learning often occurs through reflection. Perhaps rather than viewing the classroom as a place of prospective learning, we should view it as a place where reflection and thus the transformation of previous experience (and in itself learning) into

knowledge occurs. Understanding that the mind is contained within a body and acts as such, we should place experience and guided reflection at the forefront of education, focusing on active manipulation of information and experience, rather than treating the mind as a receptacle of knowledge, a wasteland in which the garbage of knowledge has been carelessly placed.

Here I present a model to help students and teachers alike at various levels of education. In this experiential-learning model I pair undergraduate students in psychology with current teachers to work together to identify teaching practices that are currently supported by research as well as identifying new ways to incorporate research findings about the brain into current practice. This model of education benefits all groups involved, college students (by offering concrete experiences in which they can ground their understanding and later reflect upon), teachers (by offering them ways to improve any aspect of their classroom with minimal time and money investment) and students (by improving their experiences in cognitive, behavioral and social development at school).

Course objectives

Develop a deeper understanding of course concepts

The concepts of learning, memory and cognition offer a very broad base of abstract knowledge for the students to connect their real experiences to. Although students will work with teachers to identify what particular areas of the teacher's teaching practices are to be focused on, students will be able to observe students in all of their interactions and activities. Whether the student is working on issues of developmental disabilities, behavior issues, emotional problems or enhancing learning and memory, the real interactions between students and teacher will provide numerous real life examples of course concepts. Having students reflect after each interaction will also help to shape their understanding. By continually reflecting on progress, students are able to plot their change in view and understanding of the issues that they are confronting.

Develop a deeper understanding of research methods

Although the project does not look like a traditional research project, many of the same elements exist. Earlier I described teachers as the most practical cognitive neuroscientist. Every teaching practice is something of an experiment, with the classroom as a laboratory and student outcomes as results. Undergraduate students will be required to use class concepts and primary literature to ground their understanding in the psychological/neuroscientific background. From that research, students will work with teachers to establish a way to incorporate that information into teaching practice. Results will be the resultant behavior after the change. Much of the results will be qualitative rather than quantitative, but working with the teacher and reflecting on their experience can give students a better understanding of even subtle changes.

Evidence for Student Learning

Synthesizing abstract knowledge with experience

In this course the experience with the teachers in the classroom becomes another text. Students are expected to synthesize their experiences and the experiences of their classmates with the course material. Students' experiences and searching for ways to change education will hopefully challenge students beliefs about the current educational model and make them think

about education and society on a larger scale outside of the individual classroom they experience.

Develop a deeper understanding of research methods

The goal of the course is not to necessarily develop a "successful" new teaching practice, but rather to critically evaluate how the current model can potentially be altered based on current research understanding. The critical evaluation followed by working through the practical application of the research to the classroom is a step that a researcher does not always make very transparent. It will be important for the students to root their changes in the research so that they are able to argue why and how their proposed change could potentially positively affect the students.

In this course, experience, permeates the themes and lessons. The course content investigates how the brain functions in thinking, learning and memory. The role of experience in paramount in learning and the role of experience is emphasized through experiential-learning.

Experience

Before the start of the semester, the course instructor will contact local area schools in order to identify willing teachers to work with. These teachers will then be interviewed in order to determine what area of their teaching practices they hope to revise with the psychology/neuroscience research. With this information, students will then be able to select teachers who want help in a particular area that the student also has interest in.

Once the semester starts, the LCM class will spend the first month going through the topics of the course in order to provide a conceptual foundation upon which they will be able to reflect upon the rest of the semester. The final two months of the course will include class meetings in which the course concepts are again revisited, but this time with input from the experiences of the students working in that area. Class time will be devoted to discussion and reflection on the experiences as they relate to the concepts. The students will be divided into small groups of two or three students and they will choose teachers who are looking for help in concepts that the students are also interested in. The student groups will be expected to work with their teachers two hours a week for the rest of the semester, observing the teacher, speaking with aids and students and working with the teacher to craft the new teaching practice.

Assignments

- A two page reflection of each meeting connecting experiences to course concepts while also addressing questions from a smorgasbord of questions that are designed by the course instructor to place the learning and experience in a wider context (see Appendix)
- A 10 page literature review that presents current psychological/neuroscientific understanding of the topic that they are working on with the teacher
- A proposal of the teaching practice that they develop with the teacher
- A "how-to guide" for implementing the teaching practice so other teachers could use the model in their own classrooms

Final Project and Synthesis

- A 25 minute powerpoint presentation that presents the issue identified by the teacher they worked with, the psychological/neuroscientific evidence for a proposed change to the

teaching practice, the teaching practice they identified and created and commentary from the teacher about what as resulted from the change.

- A final 10 page reflection that comments on both their experience and the experience of their classmates.

Service-learning objectives

Engagement

Experiential-learning is a teaching methodology that combines community experience with classroom learning in a mutually beneficial collaboration. This definition is clarified by looking at three essential aspects of experiential-learning: it involves reflection, it is reciprocal and it aims to cultivate a sense of civic responsibility.

Reflection

Experiential-learning must involve reflection in order to be an effective teaching technique. Students must engage in critical reflection about the connections between their experiences and the academic content. To be successful, students must apply concepts from the classroom to their experience. Through journals, classroom discussions and a final paper, student's reflections will be assessed.

Reciprocity

Experiential-learning must be reciprocal where both the "agency" (here teachers) and the students themselves, both gain from the experience. This is one way that makes experiential-learning different from volunteering, because students are not just providing a service to the community. Rather, they are participating in a substantive activity that fulfills a community need, and are using skills, applying theories, and integrating course content in their experience. They are engaged in "learning by doing," extending the walls of the classroom to the community at large. Students benefit from the opportunity to practice skills and gain experience, while the agency benefits from the service the students provide.

Civic Responsibility

Cultivating civic responsibility helps students to understand their community and fulfill community needs through their experience. This goal of the course is less well defined and not as tied to the subject material at hand. Ideally, students should identify why they are working with teachers to help them change teaching practices. A number of questions to reflect upon include: what has made teaching practices stagnate or misled, what political or social barriers have prevented teachers from being able to try to change their teaching practices? Students are encouraged to question the norms of education and evaluate the potential successes and shortcomings of our current educational model. In this way, they can better critique their work and reflect upon their own learning process. The critical reflection involves learning to extend the abstract course concepts to their own experiences and postulating how and why they match or don't match. The goal of civic responsibility address an institutional goal of helping students recognize their role in a broader community and working to make society a better place.

Possible future applications

The model of experiential-learning presented here, abstracted to a more basic level can be applied to many different contexts. In this particular application, undergraduate students (in

neuroscience) use their expertise in a particular content matter to help answer questions of a community partner (teachers) and develop new (teaching) practices that are supported by the undergraduate student's area of expertise (neuroscience). This same model can be used in a number of different contexts. Business students could work with non-profits to implement new practices or design/marketing students can work with local small business to market and implement a new website. In both cases, students are working with community members to share their expertise and work with them to address needs and questions that they have. On a smaller scale I introduce an experiential-learning project where students design educational material that introduces children and adults to concepts in psychology/neuroscience (see Appendices 4; 5; 6).

Possible limitations/challenges/concerns

Placing a need where it is not wanted

One of the biggest challenges is the possibility that the community partner does not want to work with us. Often in experiential-learning projects, there may be the perception that the members of the university are "coming in on their white horses to save and help" the community members. This perception can create an antagonism before a project ever starts. My way of addressing this problem was to survey the teachers before hand. I created a survey that included both questions about basic neuroscience as it related to education and also addressed questions about their interest in experiential-learning. I thought that with this survey I could do two things, one, address the need and two, find people who were interested in participating outright. I thought with the neuroscience questions that I would be able to show the teachers, that there is a deficit in neuroscience knowledge that we could remedy. However, this solution too could be a problem because people rarely like being told that they are not doing things correctly or do not know things.

Administrative Obstacles

Another obstacle that I worry about and have begun to face is the challenge of administrative restrictions. With the first school district that I sent my survey to I was informed that there were certain channels that I needed to go through to contact teachers. I had worked out with the IRB at Iowa that I would either collect e-mails from public repositories or request them from administrators. I looked on the school district's website for information regarding surveys and conducting research and found no links or information, however I did find the e-mail list of all employees in the district. I (incorrectly) assumed that I could use those e-mails to contact teachers and did so as a bcc mass e-mail. After the district asked their teachers to wait to fill out the survey until it had been approved appropriately, I found out that the administration was not interested in the project (regardless of the mistaken e-mailing). Now that I've made that mistake once, I hope I can navigate working with community partners more successfully in the future. I think the most important lesson here is to treat the community partner with humble respect meaning that the relationship that you hope to form is supposed to be mutually beneficial and presented as such.

Preparation time

A more personal obstacle is the problem of time. Over the course of the semester in the service learning special project course (in which this work was produced) we heard from a number of practitioners of service-learning techniques. Many of them suggested that service-

learning is a project that should wait until after tenure and that after that it still takes a lot of time. In order to run a successful project there will need to be a lot of time put into preparation in order to give the project the best chance to succeed. One of the most exciting and scary aspects of service-learning projects is the lack of control and direction. Even the best-laid plans are susceptible to change and failure, and while that is scary, I think that learning in those circumstances provide some of the best learning opportunities.

Assessment

Experiential-learning is meant to provide real, concrete experience in which to ground class concepts. Since no experience will be the same and the reflection on experiences will be different, it is hard to know what students are pulling from the experience and how they are connecting the concepts of the course. While students will be assessed on course content with traditional measures (e.g. tests), they will also be assessed by their reflections both throughout the semester and at the very end. The reflections throughout the semester will be meant to check-in with the students to see what they are getting out of their experiences. A fear of mine is that students will perceive the experiential part as too much work and lose interest in it. However, I want to make sure that they know that I feel it is the most important part, not only for learning class concepts but in preparing them for whatever their future holds. The particular intricacies of any class can be easily forgotten or later referenced, but the experiences of identifying and solving problems and working with others will be useful no matter the situation.

Conclusion

When I began the course, I wasn't even sure what service-learning was. Over the course of the semester, hearing from a number of guest speakers who practice service-learning in their own course, I am encouraged by their experiences and stories. While it appears that service-learning is often difficult to run well, when it is, it appears rewarding for all involved. I am however, surprised at how difficult service-learning often appears to be to implement. This surprise was then confirmed in my own experience in my first attempt to reach out to a community partner. Going forward, I see the value in making learning meaningful and having an impact beyond the walls of a classroom, but I am concerned about the reception of the learning model outside of the classroom at both the community and administrative levels. I think it is important to be thoughtful of the community partners and what they have to offer you, not just what you want to bring to offer to them. In the example I offer here, it would be impossible to implement the project without the cooperation of the teachers. The teachers and their experience is what gives the undergraduates the real-life examples of the lessons from our course.

One aspect of service-learning that has appeared so interesting is that there are no guarentees in service-learning. Every experience is going to be different. Every student and community partner brings something new and unique to the table and depending on the context of the current time, different experiences will occur. It seems like in a traditional classroom, it may be difficult to distinguish from year to year, but in the projects and products of service-learning will always be different. The variety and uniqueness, as well as the ability to guide ones leaning are very appealing.

By: Jake Kurczek

I am a neuroscience PhD student. My research interests revolve around various aspects of language processing in the brain, especially the interaction of declarative memory and language and embodied aspects of language. I am also interested in the neuroscience of learning and education, including neuroscience literacy (e.g. the Brain Discovery Fair, Brain Bee) and neuroscience education (e.g. The Iowa Educating Brains Initiative).

Appendices

Appendix 1. LCM Syllabus

Psychology
Learning, Cognition and Memory

Classroom
University of Iowa
The College of Liberal Arts and Sciences
Neuroscience Program

Time, Days
Semester

Instructor: Jake Kurczek
Office location and hours: Times, and by appointment; Room 2155-H RCP
Phone: 319-353-5334
Email address: jake-kurczek@uiowa.edu

Department Chair: Dan Tranel
Office: 2155 RCP
Phone and email: 384-6050, daniel-tranel@uiowa.edu
Department office: 357 MRC; Linda Hurst; 384-4470; linda-hurst@uiowa.edu

Required Texts

All texts will be available at the college bookstore

1.
Publisher:
ISBN:

Description

Major course assignments

- A two page reflection of each meeting connecting experiences to course concepts while also addressing questions from a smorgasbord of questions that are designed by the course instructor to place the learning and experience in a wider context
- A 10 page literature review that presents current psychological/neuroscientific understanding of the topic that they are working on with the teacher
- A proposal of the teaching practice that they develop with the teacher
- A "how-to guide" for implementing the teaching practice so other teachers could use the model in their own classrooms

Final Project and Synthesis

- A 25 minute powerpoint presentation that presents the issue identified by the teacher they worked with, the psychological/neuroscientific evidence for a proposed change to the teaching practice, the teaching practice they identified and created and commentary from the teacher about what as resulted from the change.
- A final 10 page reflection that comments on both their experience and the experience of their classmates.

Experiential-learning Component

Experiential-learning is a teaching methodology that combines community experience with classroom learning in a mutually beneficial collaboration. It involves reflection, it is reciprocal and it aims to cultivate a sense of civic responsibility.

Reflection

Experiential-learning must involve reflection in order to be an effective teaching technique. Students will engage in critical reflection about the connections between their experiences and the academic content. To be successful, students will apply concepts from the classroom to their experience. Through journals, classroom discussions and a final paper, student's reflections will be assessed.

Reciprocity

Experiential-learning must be reciprocal where both the "agency" (here teachers) and the students themselves, both gain from the experience. This is one way that makes experiential-learning different from volunteering, because students are not just providing a service to the community. Students are participating in a substantive activity that fulfills a community need, and are using skills, applying theories, and integrating course content in their experience. They are engaged in "learning by doing," extending the walls of the classroom to the community at large.

Civic Responsibility

Cultivating civic responsibility helps students to understand their community and fulfill community needs through their experience. The goal of civic responsibility address an institutional goal of helping students recognize their role in a broader community and working to make society a better place.

Schedule of course assignments and deadlines*

Week 1 – Introduction to LCM and Experiential-learning
READING:

Week 2 –
READING:

Week 3 –
READING:

Week 4 –
READING:

Week 5 –
READING:

Week 6 –
READING:

Week 7 –
READING:

Week 8 –

Week 9 –
READING:

Week 10 –
READING:

Week 11 –
READING:

Week 12 –
READING:

Week 13 –
READING:

Week 14 –
READING:

Week 15 – Present Projects
*Tentative schedule subject to change without notice as instructor deems necessary

Appendix 2. LCM Framework

The Students

This experiential-learning model will be introduced in a Learning, Cognition and Memory course. This is generally an upper-level elective course for psychology majors. The course material covers the current models for psychological development in learning and cognition while also grounding these understandings in the workings of the brain. Two important aspects are generally missing from the class, the first including the actual observation of learning and cognition changes. The second missing element includes the further development of research skills. Whether the skills being developed include: how to read scientific literature, how to design and implement experiments or how to analyze and situate results, psychology students need to continually develop their mastery of research methods. The experiential-learning model in this course will provide students real experience in research (gathering research to support ideas, working collaboratively, designing teaching practices to implement, observing how those practices change behavior) as well as the opportunity to reinforce course concepts through concrete experiences and reflection.

The Community Partner

Teachers are the cornerstone of this model because they serve as the interface of the concepts and the concrete experiences for the undergraduate students. Teachers are also in an interesting place because they not only serve as teacher to their students, but also serve as a student in relation to the "teacher" undergraduate students. Since we are valuing experience in this model, teachers will have the opportunity to choose what areas of their teaching practices they want to focus on and enhance with psychology/neuroscience research. This is also a practical consideration since the undergraduate students are guests in the teacher's classroom and there are very few people who could stand being criticized for doing what they do and how they do it by people they assume to have less expertise.

Appendix 3. Reflection questions for weekly reflections

Reflection Questions

1. Why did I choose this teacher?
2. What have I learned about this issue or about life?
3. What have I learned about myself? What did the experience mean to me?
4. Did you make a difference? Why or why not?
5. How is this experience related to my studies?
6. How is this service related to my career objectives?
7. What would I do differently next time?
8. What should society do about this issue?
9. What am I going to do about this issue?
10. How will this issue change the next week, month, or year of my life?
11. How has this experience affected my life goals?
12. What more needs to be done?
13. What is the identified problem or need?
14. How is your teacher addressing that need?
15. Why are you needed?
16. What are some of your perceptions or beliefs about the students you will be working with?
17. What fear, if any, do you have about working in the community?
18. What do you hope to gain from this experience?
19. What have you learned about yourself?
20. What have you learned about your community?
21. What have you contributed to classroom/school?
22. What values, opinions, beliefs of yours have changed?
23. What was the most important lesson learned?
24. How have you been challenged?
25. What should others do about this issue?
26. What impact did you have on the community?
27. What has made teaching practices stagnate or misled?
28. What political or social barriers have prevented teachers from being able to try to change their teaching practices?
29. What is different in society today versus 10, 20, 50, 100 years ago that changes how we should educate students?
30. How have students changed?
31. How hard was it to communicate the psychological/neuroscientific information to the teachers?
32. Should teachers become proficient in psychological/neuroscientific concepts or just focus on how to be a good teacher?

Appendix 4. Introduction to Psychology (Experiential learning component) Syllabus

Psychology
Introduction to Psychology

Classroom
University of Iowa
The College of Liberal Arts and Sciences
Neuroscience Program

Time, Days
Semester

Instructor: Jake Kurczek
Office location and hours: Times, and by appointment; Room 2155-H RCP
Phone: 319-353-5334
Email address: jake-kurczek@uiowa.edu

Department Chair: Dan Tranel
Office: 2155 RCP
Phone and email: 384-6050, daniel-tranel@uiowa.edu
Department office: 357 MRC; Linda Hurst; 384-4470; linda-hurst@uiowa.edu

Required Texts
All texts will be available at the college bookstore

1.
Publisher:
ISBN:

Description

Major course assignments

Experiential-learning assignments
- A presentation of the psychology topic
    1. Designed for children
    2. Designed for adults
- A "how-to guide" for teaching children about the topic with suggestions for activities
- A reflection of how their topic addresses a community need and helps students

Experiential-learning Component

Experiential-learning is a teaching methodology that combines community experience with classroom learning in a mutually beneficial collaboration. It involves reflection, it is reciprocal and it aims to cultivate a sense of civic responsibility.

Reflection

Experiential-learning must involve reflection in order to be an effective teaching technique. Students will engage in critical reflection about the connections between their experiences and the academic content. To be successful, students will apply concepts from the classroom to their experience.

Reciprocity

Experiential-learning must be reciprocal where both the "agency" (here teachers) and the students themselves, both gain from the experience. This is one way that makes experiential-learning different from volunteering, because students are not just providing a service to the community. Students are participating in a substantive activity that fulfills a community need, and are using skills, applying theories, and integrating course content in their experience. They are engaged in "learning by doing," extending the walls of the classroom to the community at large.

Civic Responsibility

Cultivating civic responsibility helps students to understand their community and fulfill community needs through their experience. The goal of civic responsibility address an institutional goal of helping students recognize their role in a broader community and working to make society a better place.

Our Project

As a class, we will create a web--based resource for students and adults to learn about neuroscience. You will be asked to contribute to this project over the course of the semester (i.e. sharing resources that students create as they construct their presentations). My thinking is that given the lack of literacy in neuroscience, others who are eager to psychology and neuroscience could access this material for teaching and learning alike.

Schedule of course assignments and deadlines*

Week 1 – Introduction to Psychology and Experiential-learning
READING:

Week 2 –
READING:

Week 3 –
READING:

Week 4 –
READING:

Week 5 –
READING:

Week 6 –
READING:

Week 7 –
READING:

Week 8 –

Week 9 –
READING:

Week 10 –
READING:

Week 11 –
READING:

Week 12 –
READING:

Week 13 –
READING:

Week 14 –
READING:

Week 15 – Present Projects
*Tentative schedule subject to change without notice as instructor deems necessary

Appendix 5. Introduction to Psychology Class Framework

The Students

This experiential-learning model will be introduced in an Introduction to Psychology course. This is generally an intro-level elective or required course for psychology (non)majors. The course material is a survey of psychology spanning all topics and sub-disciplines. Two important aspects are generally missing from the class, the first including producing something meaningful and the second missing element includes the further development of research skills. Whether the skills being developed include: how to read scientific literature, how to design and implement experiments or how to analyze and situate results, psychology students need to continually develop their mastery of research methods. The experiential-learning model in this course will provide students real experience in research (gathering research to support ideas, working collaboratively, producing learning materials) as well as the opportunity to reinforce course concepts through concrete experiences and reflection.

The Community Partner

The partner in this situation are students and adults alike. The students in the course will take the course content and distill it down so that non-experts and children alike can learn about neuroscience.

Appendix 6. Introduction to Psychology Topic List

Experiential Learning Topic Suggestions

Cognition
Memory
Learning
Language
Free will
Neuroeconomics

Perception
Visual Illusions
Vision
Taste
Smell
Touch
Sleep

Drugs
Caffeine
Alcohol
Cocaine
Marijuana

Diseases
Schizophrenia
Parkinson's Disease
Alzheimer's Disease
ADHD

Miscellaneous
Exercise
Movement
TBI
Stroke
Emotion

Appendix 7. Neuroscience and Education Annotated Bibliography

While the United States of America (US) has long held the belief that it is better than everyone at everything, recently these beliefs have begun to look a lot more like wishes. In particular, the education rankings of the US have been plummeting, in fact they have fallen so far as to be considered “average” in the world (Johnson, 2010). In the US, “average” is considered failure, but rather than addressing the causes, the US has thrown everything at the symptoms, looking for a quick fix. While, school districts seem to always be in search of the "next thing" that can help reverse the current trend, whether through technology (e.g. iPad) or through using different models of education (e.g. the "Finnish model") schools are constantly scrambling. However, with education budgets gouged and teacher benefits and salaries slashed, the downward trends in the rankings do not look to be changing anytime soon. The state and national governments (read: stingy anti-intellectualists) looking to place the blame, have generally been turned to the estimated 3.6 million teachers and the approximately 70 million students across the US, but rather than focusing on them, we actually turn our focus on the outdated teaching practices being used by mis- and undereducated teachers.

One solution that can address these root causes of the problems in our education system, which can benefit students at both the primary and secondary levels, is the "service-learning" model of education. In the educational context, neuroscience students in college could participate in a service-learning project in which they engage with educators to identify neuroscience-supported ways to improve their teaching practices. This model of education benefits all groups involved, college students (by offering concrete experiences in which they can ground their understanding and later reflect upon), teachers (by offering them ways to improve any aspect of their classroom with minimal time and money investment) and students (by improving their experiences including cognitive, behavioral and social at school). While the future of the United States is at stake, instead of actively tanking our educational system, we could attempt to improve it by assessing neuroscience literacy and interest in adapting neuroscience principles into practice, with the hope that we can fundamentally alter education and later benefit millions of students and teachers across the US.

The following bibliography includes research related to education and neuroscience and revolves around three subjects; one, that neuroscience is important to education, two, that experience and reflection are essential to the learning process and three, that service-learning can serve to tie the first two subjects together. No matter, what you call "service-learning" (or experiential-learning as I choose to) there appears to be endless permutations of 1) service and 2) learning synonyms with different combinations of the 1) the relationship between the two domains and 2) the focus on two domains, education and community. In my own approach, while I view the education component as the primary purpose, it is dependent on the experience (and thus the community interaction). However, I view any benefit for the community as merely a consequence of the quality of the educational experience. Inspired by psychologists (e.g. Vygotsky; Hua Liu & Matthews, 2005), philosophers (e.g. Dewey; Kolb, Boyatzis, & Mainemelis, 2000), and neuroscientists (Damasio; Immordino-Yang & Damasio, 2007), learning is best accomplished through experiences and is actively constructed rather than mechanically acquired. While the classroom offers the opportunities to be exposed to principles and concepts and later reflect upon those matter, the world offers the experiences and the opportunities to explore and form one's own understanding of the subject matter. Baker and colleagues (1997) note that the transformation of experience into learning often occurs through reflection. Perhaps rather than viewing the classroom as a place of prospective learning, we should view it as a place where reflection and thus the transformation of previous experience (and in itself learning) into knowledge occurs. Understanding that the mind is contained within a body and acts as such, we should place experience and guided reflection at the forefront of education, focusing on active manipulation of information and experience, rather than treating the mind as a receptacle of knowledge, a wasteland in which the garbage of knowledge has been carelessly place.

Section 1: The importance of the relationship between neuroscience and education

Dubinsky, J. M. (2010). Neuroscience Education for Prekindergarten-12 Teachers. *Journal of Neuroscience*, *30*(24), 8057–8060.

Dubinsky (2010) addresses the debate concerning the ability of neuroscience to inform primary school teachers teaching practice. While some view knowledge of neuroscience as essential to a practice that completely revolves around the ability to change and alter the brain and mind, others view neuroscientific principles as too far removed from the classroom context. Dubinsky (2010) goes on to describe "BrainU", a course on neuroscience for educators. This example can be adapted to a service-learning model for teaching educators about neuroscience. Rather than distilling the neuroscience information down through multiple different sources, in the experiential-learning model, students in neuroscience would work together with educators to help them understand neuroscience. Through collaboration and reflection, neuroscience students and educators can work to build knowledge together and reinforce previous knowledge. This more dynamic and personalized education for the educators allows them to tailor their neuroscience education to their particular needs. Educators at the elementary level are dealing with very different developmental issues than teachers who are dealing with adolescents. One major problem noted with the BrainU design is that funding is a prerequisite. With the experiential-learning model, grants can be avoided as the neuroscience students, through reinforcing their own conceptual understanding are able to provide educational materials.

Geake, J. (2011). Position Statement on Motivations, Methodologies, and Practical Implications of Educational Neuroscience Research: fMRI studies of the neural correlates of creative intelligence. *Educational Philosophy and Theory*, Motivations, Methodologies, and Implications of ENR, *43*(1), 43–47.

John Geake (2011) argues that educational neuroscience must be relevant to educational theory and practice, but that for this relationship to work, they give-and-take must go both ways. In this reciprocal relationship, Geake (2011) notes that educational issues should inspire a set of cognitive neuroscientific questions, which after investigation, should provide results that have implications and applications for educational policy and practice. While Geake's (2011) proposal sounds nice in its intent, the communication between neuroscientists and educators has been difficult and restrained at best. While Geake (2011) sees the capacity of cognitive neuroscience to answer questions in education, I already see

these questions already being answered. Whether through the use of differing vocabulary or the ineffective communication between the parties involved, the transference of information from cognitive neuroscience to education has been limited. Geake's proposal to solve the gap between education and neuroscience is through further initial teacher training in neuroscience, combined with professional development programs (perhaps akin to BrainU) that would create the opportunity for teachers to inspire new questions from the field for cognitive neuroscience to answer. Again these broad professional development courses appear unable to respond to the individual needs of a particular teacher. Classes change, environments change and subject matter differs greatly. While it is important for teaching practices across disciplines to complement one another, there is no one-size fits all answer for which cognitive neuroscience has the clue. Personalized, interactive neuroscience education allows teachers to tailor the information to their particular wants and needs.

Herculano-Houzel, S. (2002). Do You Know Your Brain? A Survey on Public Neuroscience Literacy at the Closing of the Decade of the Brain. *The Neuroscientist*, *8*(2), 98–110.

Herculano-Houzel (2002) presents the first of two papers that describe the problems of public literacy in neuroscience. The 1990s were dedicated as the decade of the brain by President George Bush Sr. Although Herculano-Houzel (2002), presents results from Brazil, the explosion and impact of neuroscience, including development, research, techniques and understanding, stretched far beyond the bounds of the United States. In Herculano-Houzel's (2002) study, she found that the incidence of "correct" answers among the public improved with schooling and then with the reading of popular science magazines and newspapers. Heculano-Houzel (2002) concludes that the survey provides information about the public neuroscience literacy and provides information about how to improve communication between neuroscientists and the public. By finding the areas that are the most misunderstood, the neuroscientists and science writers can work together to communicate accurate information. While the work proposed here is to educate teachers, one may imagine that teacher's knowledge and misperceptions about the brain may track well with similarly educated public members. However, if that's true, we should make a concentrated effort to educate a profession whose responsibility

is to positively alter and guide brain development. Identifying common misperceptions among trainee teachers and current educators may help in developing a general neuroscience primer related to education. Further, information about teacher neuroscience literacy can help to alter current educational practices for trainee teachers.

Howard-Jones, P., Franey, L., Mashmoushi, R., & Lioa, Y. (2009). The neuroscience literacy of trainee teachers. In *British Educational Research Association Annual Conference* (pp. 1–39). Presented at the British Educational Research Association Annual Conference.

Howard-Jones and colleagues (2009) present the second study of neuroscience literacy. This study assesses the literacy of teachers in training in England. Results indicated that trainees' ideas reflected misconceptions in public circulation and notions promoted by popular brain-based educational programs. Most of the trainee teachers in the survey did not accept, or were unsure, about whether mental activity derives from biological brain function. Trainee teachers place equal importance on home environment and education as determinants of educational outcome, with genetics a significant but smaller influence than either. The authors conclude that in the absence of formal training, trainee teachers acquire their own ideas about brain function, which may be detrimental to their practice as teachers. As I hypothesized with the previous study of neuroscience literacy, trainee teachers appear to have the same level of misperceptions about the brain. With the importance of the brain to learning, I agree with the authors that those misperceptions can be detrimental to teaching practices. This study combined with the other neuroscience literacy study demonstrates the need and importance of further neuroscience education for teachers. A willingness to learn and change teaching practices could drastically change how teachers approach both teaching and learning and the learning environment. By working with neuroscience students to learn neuroscientific principles, we not only increase teacher neuroscience literacy but also allow neuroscience students to learn and communicate their knowledge better as well.

Section 2: Experience and reflection in learning

Baker, A. C., Jensen, P. J., & Kolb, D. A. (1997). In Conversation: Transforming Experience into Learning. *Simulation & Gaming*, *28*(1), 6–12.

The authors focus on conversation in debreifing following games and simulations. They suggest the role of the teacher is that of a facilitator who is open to the unique experience of each individual in the game. Creating a safe and receptive environment allows for surprising and personal learning. The authors also view games and simulations as central to the learning experience because they allow for conceptualization and experience with the relevant concepts and theories. However, it is then through guided reflection and conversation that solidifies and guides the connection of experience to concepts. Reflection allows for an individual learning experience. With the nature of knowledge accessibility today, there should be less of an emphasis on rote memorization and an increased emphasis on problem solving and communication. Often times students find particular subject matter boring or they "don't see the point" of studying certain things. Guided reflection forces students towards seeing differing perspectives and the conflict moves participants towards a more complex understanding of the material. Being able to bring in your own experiences, and put your own learning agenda, rather than the teacher's, at the front of learning, makes for a more personalized and useful learning experience.

Campbell, S. R., Bigdeli, S., Handscomb, K., Kanehara, S., Macallister, K., Patten, K. E., Robb, A., et al. (2007). The ENGRAMMETRON: Establishing an educational neuroscience laboratory. *SFU Educational Review*, *1*, 17–29.

This article describes the conception and implementation of an educational neuroscience laboratory that is grounded in experiential learning and provides a model for using experience and conversation to teach neuroscience. Justifying the claim that experience is central to cognition has become much easier in the last 30 years. Embodied cognition, the idea that the mind is not only connected to the body but that the body influences the mind, is seen as counterintuitive based on traditional views of the mind. The traditional view of the mind reduces the lived experience to mere processes and functions. By viewing the lived experience in the mind, embodied cognition provides an educational approach for learning and teaching.

At the heart of embodied cognition is the understanding that we learn through our experiences in the world. Correlations between bodily and mind experiences ground our thoughts in the outside world.

These body/mind correlations are then demonstrated through our behavior. For example, we have formed the understanding of good and bad through our experience along a vertical axis, we come to view good as up and down as bad. As children, most of the interesting things occur above us, we "look up" to things, where as everything down is bad, such as falling down or being "put down." This grounded understanding then comes through in our language, "lifting someone's spirts" or "feeling down," and behavior, standing tall, or slumping down. With this in mind, we can harness the brain's tendency to strengthen correlation and use experience to ground abstract concepts.

Daudelin, M. W. (1996). Learning from experience through reflection. *Organizational Dynamics*, *24*(3), 36–48.

Daudlin echos the sentiments of {Baker:1997et} viewing formal reflection as essential to learning. She approaches formal reflection of an industrial/organization perspective and emphasizes developing the capacities to learn from current working situations and adapting to learn in new situations. She emphasizes the importance of manager's own work experience over the theoretical knowledge held by professors or consultants in relation to learning from work. She discusses the results from a survey regarding reflection stating that just one hour spent reflecting with general questions and guidelines either alone or with a helper can significantly increase learning. This model can be applied to education where the educator is viewed as the manager and the students as employees. The educator offers opportunities for the students to experience learning and then uses class time to reflect on experience. Students are generally in the classroom only three hours per week. An old adage was that for every hour in the classroom, two hours should be spent studying. For a student taking 15 credit hours, this would equal 45 hours a week devoted to class work, with only 3 hours in one particular class, students are expected to absorb everything in 1/3 of their time and rehearse the other 2/3. Instead, students could spend 2/3 of their time learning and experiencing, and 1/3 of their time in guided reflection and discussion, seeing other's experiences, pulling from and connecting to differing viewpoints and experiences. One drawback of this approach is its application to large classrooms. Lecture halls of 400 students would not offer much opportunity for personal engagement of each student with the teacher. Moving from the traditional

passive classroom to the engaging, more critical and thoughtful classroom may be difficult and might be expecting too much for students trying a radical new approach to learning.

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99–107.

Hmelo-Silver and colleagues (2007) challenge an earlier report by Kirschner and colleagues (2006) in which they describe problem-based learning (PBL), inquiry learning (IL) and unguided discovery learning (UDL). Hmelo-Silver and colleagues (2007) disagree that PBL and IL are like UDL because the former employ scaffolding to reduce the cognitive load and allow students to learn in complex domains. Further, they claim that PBL and IL are important for addressing goals in content knowledge and in "soft-skills" such as collaboration and self-directed learning. Both Baker (1997) and Daudelin (1996) concur with the overall message of Hmelo-Silver and colleagues (2007). Through experience, one is better able to learn concepts for themselves, but it is not just the experience, but the re-enforcement of that learning through reflection or scaffolding that really makes a difference. While PBL, IL, and UDL may all have experiential-learning at their core, it appears that only PBL and IL include the scaffolded re-enforcement of reflection and guided instruction. Though I agree with Hmelo-Silver and colleagues (2007) in their strong backing of experiential-learning techniques, I see their place as one-half of the learning process. Introduction of the concepts through readings and lectures occurs first outside the classroom. Then experiential paradigms, such as PBL or IL occur either outside the classroom or inside. Finally scaffolded experiential learning and reflection occur inside the classroom to reinforce all of the practices and concepts introduced earlier. Hmelo-Silver and colleagues (2007) end with a quote from Confuscius that succinctly describes the benefits of experiential learning, "Tell me and I will forget; show me and I may remember; involve me and I will understand."

Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education*, *1*(1), 3–10.

Immordino-Yang and Damasio (2007) discuss the importance of emotion in learning.

Neurobiological evidence has suggested that the traditional cognitive functions that are recruited in school (learning, attention, memory and decision making) are profoundly affected by and subsumed within emotion. Further, evidence from brain-damaged patients suggest that emotion-related processes are required for skills and knowledge to be transferred from the school environment to the real-world. One of the most important points to take from this article is the way that emotion is defined by the authors. Emotion as defined by Damasio is a basic form of decision-making that allows people to respond to different situations. Through the use of body signals the individual relates current environmental cues to previous experiences. This issue is important to the point that I am making here, that experience and reflection are of utmost importance to learning. Emotion appears to be one form of experience that helps to solidify and enhance learning. Other forms of experience may serve similar roles. This paper is also important in that it represents a contribution to educational neuroscience from one of the foremost experts in neuroscience. For the relationship between neuroscience and education to be healthy and productive, not only do teachers want to learn neuroscience, but neuroscientists need to be willing to investigate issues that are relevant to education and communicate them well. This goes back Geake's (2011) point that neuroscience and education need to work together in order for neuroscience to be relevant and influential.

Kolb, A. Y., & Kolb, D. A. (2009). The learning way: Meta-cognitive aspects of experiential learning. *Simulation & Gaming*, *40*(3), 297–327.

Kolb and Kolb (2009) discuss the personal process that occurs with reflection. Meta-cognition is a process of awareness, or thinking about thinking. This process is what we are trying to encourage and develop through reflection. Kolb and Kolb (2009) discuss their experiential learning model in which concrete experience feeds reflective observation, which then goes through abstract conceptualization before being actively experimented with. This model speaks well to the experiential-learning model for neuroscience students. Through concrete experience working with, observing and applying neuroscience principles with educators, neuroscience students are able to begin the learning cycle as understood by Kolb and Kolb. However, the experience is just the beginning of the cycle, meta-cognitive processes,

thinking about learning, completes the learning cycle. As many other articles have discussed, it is the importance of reflection that solidifies the learning. With the experiential learning theory presented by Kolb (Kolb, Boyatizis, & Mainemelis, 2000), a scientific grounding of reflection is presented. While teachers can present a learning environment that allows learners to explore and change learning, it is ultimately the learner who manages their learning. So not only is reflection necessary, but the ability to control and monitor the learning process is important. In terms of the experiential-learning model, reflection and meta-cognition appear to be important for educators as they learn about neuroscience with and from the neuroscience students.

Section 3: Experiential-Learning: The bridge between neuroscience literacy and experience

Kretchmar, M. D. (2001). Service learning in a general psychology class: Description, preliminary evaluation, and recommendations. *Teaching of Psychology*, *28*(1), 5–10.

Kretchmar (2001) presents service-learning projects for an introductory psychology course. Over 80% of students chose the service-learning project over an optional research project and also evaluated their experience favorably in terms of its impact on their learning and service. As a intro course, the course material was quite diverse. The students integrated their service-learning activities with class material through large and small group discussions as well as a final term paper in which they reflected on experiences and specific topics. I found this model as a poor example of what I view as the benefits of experiential-learning and understand why it was considered a service-learning project. As far as I can tell the students simply provided community service and reflected upon it. Since it was an introductory psychology course, and all aspects of human behavior are studied, it is relatively easy to connect experience to content. While the exact design and theoretical underpinnings of the project do not match with my needs, Kretchmar does provide recommendations for service-learning projects that will help with logistics.

Edlow, B. L., Hamilton, K., & Hamilton, R. H. (2007). Teaching about the brain and reaching the community: Undergraduates in the pipeline neuroscience program at the University of Pennsylvania. *The Journal of Neuroscience Education*, *5*(2), 1–8.

Edlow and colleagues (2007) present the only model of service learning in neuroscience and education. In this course, undergraduate students in neuroscience receive instruction in neuroanatomy, neuroscience, and clinical neurology from medical staff and students and then become community educators by integrating their new knowledge into lessons plans that they teach to small groups of high school students. This article provides a discussion of the strengths and limitations of the experiential-learning model while also discussing their own successes and problems. The program increases the knowledge of neuroscience for the undergraduate students while also providing them with successful mentors. The students also appreciate the opportunity to contribute to their community, which is at the heart of the service-learning methodology. However, with these benefits, the neuroscience course faces some challenges. The authors indicate that not only is it hard to quantify the impact on the undergraduate students, but that it is also hard to comprehensively assess the impact on the high school students. Additionally, the course finds difficulties in finding continuity with its mentorship which creates difficulties in forming long-term relationships with mentees. These same difficulties will apply to any experiential-learning model I propose. Perhaps continuity can be formed by working with the same schools or teachers, but students will turn over year by year.

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