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## Writing the Book...Literally: The Convergence of Authentic Intellectual Work (AIW) and Project-Based Learning (PBL)

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### Abstract

Using the Project-Based Learning (PBL) and Authentic Intellectual Work (AIW) models, we sought to create coursework that had value beyond the classroom. Refinements in the self-publishing book industry provide the opportunity to present student work to a larger audience and in a different, more engaging format. With the help of free software, our classes were able to publish professionally-finished books for sale on Amazon.com. This article shows how we designed, implemented, assessed and evaluated a book-writing project for graduate (leadership studies) and undergraduate (science education) students who wrote, edited, designed, and published it at the end of the course.

### Keywords

Authentic Intellectual Work, Project Based Learning, graduate, undergraduate

### Cover Page Footnote

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## **Writing the Book...Literally: The Convergence of Authentic Intellectual Work (AIW) and Project-Based Learning (PBL)**

Often the activities, assignments, tests and homework that instructors assign are considered manufactured and artificial to students, yet essential to pass the subject. Newmann, King and Carmichael contend, “Schoolwork is regarded largely as a series of contrived exercises necessary to earn credentials (grades, promotions) required for future success” (2007, p.2). This often contributes to student disengagement, or the student at best doing the bare minimum to meet requirements. The students become focused on figuring out how to comply with teacher and test requirements, rather than solving important, meaningful problems or answering interesting, challenging questions (Newmann et al. 2007). We wanted to tackle the problematic perception that university coursework is created for artificial purposes, and thus not meaningful or applicable to the world outside of the classroom.

Refinements in the self-publishing book business have provided an opportunity to present student work to a larger audience and in a different, more engaging format. With the help of free software, it is possible for a class to publish a hardcopy, bound book for sale on Amazon.com. Our hope was that presenting our students’ work in this way would not only contribute to a larger discourse, but also encourage them to understand the importance of engaging a larger audience with the purpose of further learning, even outside the classroom. Our theory of action was: if we can engage students in a project that they largely control and that has value outside of the classroom for a larger, real-life audience, then the quality of the work will be significantly better. Moreover, the process used to create the products would tease out higher-level thinking skills, professional standards and real-life work skills.

### **Authentic Intellectual Work (AIW)**

The Authentic Intellectual Work (AIW) framework (Newmann, Marks & Gamoran 1996; Newmann, Bryk & Nagaoka 2001; Newmann et al. 2007) provided a model of instructional planning that helped us attack the challenges of engaging students in relevant projects with value outside the classroom. AIW implies a distinction between the more complex accomplishments of skilled adults and the usual work students do in school (Carmichael & Martens, 2012), and aims to move students from the latter to the former.

A lesson guided by AIW has several key components: (1) student construction of knowledge, (2) disciplined inquiry and (3) value beyond school (Newmann et al. 2007). AIW moves a lesson away from the rote memorisation and passive reception of information to a much more engaging lesson involving deeper contextual issues (Scheuerell 2011). Rather than just routine application of facts and procedures, AIW involves original application of knowledge and skills. It also entails careful study of a particular topic or problem and results in a product or presentation that has meaning beyond success in school (Carmichael & Martens 2012). Students begin to make meaning by constructing their own knowledge around an idea or question and then exploring solutions in the same way as professionals and experts in the field (Carmichael & Martens 2012).

Herrington, Reeves, Oliver and Woo (2004) investigated the notion of “authentic tasks” in web-based courses, finding that a complex and sustained activity can provide meaning and relevance to sophisticated content by enabling collaborative problem-solving, justify the creation of polished products, and providing integrated assessment of achievement. Reeves, Herrington and Oliver (2002) derived 10 design characteristics of authentic tasks that include allowing students to

examine complex, real-world and relevant problems from different perspectives and using different resources with the opportunity for reflection and collaboration. Herrington et al. (2004) provided examples of activities that reflect these characteristics and contended that they provide greater meaning to otherwise decontextualised ideas, enhancing the transfer of deep and lifelong learning (Barab & Landa 1997).

AIW is supported by empirical data that shows positive achievement in K-12 schools. In the Center on Organizing and Restructuring Schools (CORS) Field Study (Newmann et al. 1996), students in an urban environment who were exposed to instruction centered on AIW principles outperformed their peers in traditional classrooms by an average of 30%. The findings of the Chicago Annenberg Field Study (Newmann, Lopez & Bryk 1998) supported these results, showing a performance margin of 30-50%. Using data gathered from its statewide assessment, Iowa's Department of Education examined the performance of students in grades 3 through 11 in schools in which all teachers engaged in AIW as their primary professional development for at least year before administering the test. Carmichael and Martens (2012) reported that this data was compared to data from an equal number of schools that were as closely matched as possible based on enrollment, race, socioeconomic status, English-language learners and disability. Comparisons of results for four subjects in each of nine grades demonstrated that students in schools implementing AIW scored significantly higher in 26 of the 36 comparisons, with higher percentages of students proficient in 32 comparisons (Carmichael & Martens 2012). Because the data, although preliminary, shows promise in K-12 education, we wanted to explore the utility of this model in higher education.

## **Project-Based Learning**

Project-based learning (PBL) is succinctly defined as “a model that organizes learning around projects” (Thomas, 2000, p. 1). In project-based learning, students work in groups to solve challenging problems that are authentic, curriculum-based and often interdisciplinary (Solomon 2003). Project-based learning offers an engaging instructional method to make learners active constructors of knowledge.

The use of projects in classrooms is not a new phenomenon, but Thomas (2000) outlined some distinguishing characteristics that define the pedagogy known as project-based learning. Thomas (2000) says project-based learning projects are central, not peripheral, to the curriculum and are focused on questions or problems that “drive” students to encounter the central concepts and principles of a discipline. Further, the largely student-driven projects involve the students in a constructive investigation that produces an outcome that is realistic, not school-like.

With the students responsible for constructing ways to approach the problem at hand, teachers' role is inherently different to the role they play in traditional pedagogies (Hmelo-Silver, Duncan & Chinn 2007). The instructors tend to work “backstage” as the learners work on the project (Gulbahar & Tinmaz 2006). Because various students may be researching various topics, the role of the teacher must be fluid, flexible and dynamic. According to Solomon (2003), the teacher's role is to guide and advise, rather than to direct and manage, student work. This does not mean that the instructor sits back and lets the project happen, as characterized by Kirschner, Sweller and Clark (2006). Instead, as demonstrated later in this article, the teacher must be an active advisor, making suggestions that sometimes deal with content and sometimes with process. In many ways, the teacher has a more important and active role in more-authentic learning experiences such as

PBL, despite the appearance of less guidance (Clough, Berg & Olson 2009; Hmelo-Silver et al. 2007).

## **Writing the Book...Literally**

Two different researchers wrote this article. Dr. Tom Buckmiller teaches graduate students and Dr. Jerrid Kruse teaches undergraduate students. The professors collaborated in the planning and met frequently to discuss the progress of each class as they used the AIW and PBL frameworks. It is important to note that although the final product of each course was an actual book, the courses were not grounded in the language arts, literature, English or even creative writing. The applicability of this method can be far-reaching and is not limited to writing courses.

With the technology available from Amazon.com and the free book-publishing software Createspace.com, our classes were able to write, edit and publish a professionally bound book at minimal cost. When the process was completed, the books were available for purchase by the public through Amazon.com and could be ordered as a digital copy, traditional softcover or hardcopy book at prices determined by the students. In the sections below, we individually share our stories of implementing the PBL/AIW frameworks wherein students in our respective graduate class in advanced leadership and undergraduate class in elementary science methods took on the task of authoring and publishing a book.

### ***Dr. Buckmiller's Graduate Class: Advanced Leadership***

When I started my class with the phrase, “We are going to write a book on leadership in this course,” I could hear the chuckles and exclamations of disbelief. This graduate, cohort-based, doctoral course took place over the course of three weekends, with a weekend between each class—approximately 29 days. Writing, editing, designing and publishing a book was going to be a great challenge, and I needed full participation from all 18 students in the class. This project was to be the focus of the class. Students understood the implications of having their name, and reputations, on a book that would be sold in the open market. While there was some apprehension, this project raised the bar in terms of quality because it would be read, and possibly scrutinised, by someone other than the professor of the class. There were essentially two broad components of this project, from which I would tease out the content standards of the course: students as writers (content) and students as leaders (process).

*Students as writers: construction of knowledge through disciplined inquiry.* I proposed some starter guidelines that included each student writing a concise chapter (20-30 pages) stemming from personal narratives, experiences, research or interests. Some students wanted to begin to flesh out a theoretical framework or literature review for their future dissertation work. Others wrote biographically about leaders who had inspired them. I strongly suggested that each writer use research and academic literature to support their chapter.

Knowing that these students would soon be writing their dissertations, I wanted to facilitate a project that helped them gain some of the skills necessary to successfully complete a dissertation: organisation of thought, giving and receiving critical feedback through collaboration, meeting deadlines, writing succinctly and concisely on a topic, APA practice and working through writer's block.

*Students as leaders: negation of power and process.* The experience was different for each student. I created the various roles, but allowed the students to choose, via voting, who would take which role. The four main teams for this project were: editors, designers, quality assurance and writers. The editors, designers and quality-assurance groups were the leadership teams.

The class voted for three book editors whose names would be on the cover and would have the final say on all decisions of the book. They would not write a chapter in the book, but would coordinate everything about the book. The class also chose three students to be on the quality-assurance team and three students for the design team. These six quality-assurance and design team students, in addition to their leadership team responsibilities, also wrote a “short” chapter (10-15 pages).

The quality-assurance team was in charge of the class peer-review process. They designed a process that allowed each chapter to be reviewed at least three times by other members in the class. The design team worked with the book-publishing software to format the chapters, sections and artwork, including the front and back cover designs. They also made suggestions regarding numerous micro-decisions including font and size, page-number position, chapter headings, foreword, introduction, style and final pricing. The leadership teams set a series of deadlines. Staying on task by meeting firm deadlines would be critical if the project was to be completed in 29 days. The schedule was: weekend one – rough draft; weekend 2 – final reviews, edits and finished product; weekend 3 – book formatting.

Loosely, the first weekend of the course included a series of guided activities that had the students vetting topics and potential chapter formats, grounding themselves in the research and literature and writing rough outlines and drafts. The second weekend was all about the writers doing the finishing work of their chapter through the review and revision process. All writers were expected to provide quality feedback to others. The quality-assurance team designed a peer-review process that provided writers with multiple reviews for consideration.

The class looked a little unconventional. Not everyone was doing the same thing at the same time. The leadership teams sometimes worked on their own, sometimes with another leadership team, and met as needed throughout the weekend. The editors worked late – until 3:00am one evening – and others on the leadership team worked beyond the course required hours. There was a certain ebb and flow of stress and comfort that occurred at different times. The division of labor ensured that everyone had important, worthwhile work.

My job was to coach, support, encourage and advise on both the content and process. As the instructor I was flexible with the time allotted for the weekend and allowed students to help make recommendations for small- or large-group meetings and individual writing, research and editing time.

These groups got the opportunity to refine leadership skills throughout the process. The three leadership teams had to make tough decisions regarding editing, timelines and direction for the writers. When considering the host of decisions, they had to decide which should be brought back to the entire group to receive input and which just had to be made. The writers watched and carefully evaluated the actions of the leadership team. Although they wanted to give input on the look and feel of the book, they also sought clear direction from the leaders in terms of due dates and feedback. Students had to carefully negotiate power through decision-making and feedback with cohort colleagues they would be seeing in class for another three semesters. They were aware their relationship would endure after this book was complete. Because the stakes were

high, and names and reputations were at stake, this exercise in leadership and followership provided a practical experience with transferable skills outside of the classroom.

The class ended with a comprehensive review of the process. I asked the students to reflect and self-assess according to these questions: How well did you meet the deadlines set forth by the instructor and the editors? Did you meet all the deadlines? How seriously did you take your role as a peer-reviewer? Explain. How open were you to receiving feedback from peers? What was difficult about this process for you? As a writer: In what ways do you think you improved as a writer as a result of this class? The feedback was extremely positive and included phrases such as: “this class was a change of pace, it was a lot of work, we are proud of the outcome. It was worthwhile.”

After the course was finished, the leadership team created a public-relations team to promote the book. That team used social media including websites, blogs, Twitter and Facebook to promote their book. The group also held a book-launch party complete with readings from the book and a signing session. Approximately 60 people, mainly family and friends, attended what turned out to be a wonderful celebration. The Dean of the School of Education opened the event, and the School paid for light refreshments.

*Assessment and Student Feedback.* It was important to assess both the outcome (final writing product) as well as the process (skills) of the project. Although the students tended to focus more on the outcome, the process (meeting deadlines, giving and receiving peer-review feedback) was just as important in my mind. Reflection on the processes provided a key analytical piece to complement the topic of the course: leadership and followership.

I assessed the outcome by using the GRE Scoring Rubric for Written Essays. This six-point scale provides feedback in the area of position, development, organisation, fluency and stylistics. Students were given a copy of the rubric at the start of class. Next time I teach this class, I will have the students self-assess their writing using this rubric.

To assess the process, each student did a self-assessment related to the critical skills of the project. The four questions elicited responses of various lengths. The probes were:

Deadlines – How well did you meet the deadlines?

Peer review – How seriously did you take your role as a peer-reviewer?

Accepting feedback from others – How open were you to receiving feedback from peers? What was difficult about this process for you?

Writing – Upon reflection, in what ways do you think you improved as a writer?

As a result of this self-assessment, I learned that the peer-review process was a bit overwhelming for some students. Some felt hesitant to give critical feedback, and some were unsure of the quality of the feedback from their peers. In future courses, I would spend a little more time modeling the feedback process and provide specific guidelines to facilitate this important part of the process.

The end-of -course feedback (anonymous) from the students was overwhelmingly positive. Using a 1-5 Likert scale (1 being “needs improvement”, 5 being “excellent”) the students’ feedback averaged 4.78 in the areas of “learning”, “engagement” and “project provided valuable skills applicable to the dissertation process”. One student wrote, “The process of giving and receiving feedback through several revisions was a good experience. Prior writing has not received as much scrutiny.” Another student commented, “I cannot think of another class where [I was] engaged in

a project like this. I think the focus on a project was excellent.” Another student wrote, “Real world brought to the classroom.”

Although I would be cautious not to overuse the book-writing concept, I am planning to use this idea in another class, School Management, which is in a different program. I will assign groups of three students to collaborate and write on one of the eight broad topics of school management. The idea of this project is to get away from the “inch deep and mile wide” concept and move towards the “mile deep” concept connected to the disciplined inquiry component of AIW.

### ***Dr. Kruse’s Undergraduate Course: Elementary Science Methods***

Many of the procedures in my colleague’s doctoral class were repeated with the undergraduate students in my elementary science methods class. For example, I used the same framework to determine and assign leadership roles: the class elected three editors, and a design team was established to take care of layout and publishing issues. Much as with the doctoral course, the editorial team set deadlines for authors, provided feedback along the way and participated in writing some chapters. The design team was responsible for creating the final formatting and layout of the book, creating a table of contents and uploading the book for distribution on Amazon.com. Although the book project was structurally similar in both classes, many modifications had to be made to support the undergraduate students in their work.

*Meeting the needs of undergraduate students.* When taking on a project to write a book with undergraduate students, some modifications and different considerations were made to account for their level of experience, confidence and knowledge base. While I borrowed many of the strategies used with the graduate students, more-extensive scaffolding was required to help students create a coherent vision for their book. For example, teams of students rather than individuals wrote each chapter. This group effort enabled students to divide tasks when appropriate as well as provide instant feedback on each other’s writing.

The most significant scaffolding I had to provide students was regarding context. Rather than basing the entire course around the book project, as was done in the doctoral course, students began the project in the last third of the semester. This placement of the project gave students opportunities to develop and apply their knowledge related to science education before taking on a challenge in which they would be sharing their thinking with the outside world. Through our course discussions and activities, students developed knowledge and confidence, which kept the book project from appearing insurmountable. Importantly, many of the course activities leading up to the book project made use of problem-based learning activities, which served as a scaffold for the more open-ended book project (Barron et al. 1998).

When embarking on the project, I provided scaffolding for students at the beginning of the endeavor so that they were working from a productive framework. For example, I proposed to students that we investigate the then-newly released *Next Generation Science Standards (NGSS)*. Many students were not aware of the *NGSS*, but immediately recognised the impact the *NGSS* might have on their future careers. In this instance, my work in science education helped identify a useful topic for their investigation rather than letting students investigate whatever they wished.

Another instance of scaffolding occurred when creating an outline for the book. Again, I used my experience and knowledge as a science educator to help bring historical and practical context to the students’ thinking. For example, I began a class discussion by asking, “What questions or concerns do you want to investigate regarding the *NGSS*?” Students’ initial reactions focused on



what is in the standards or how to read the standards. These are important issues, but do not fully investigate the implications of the NGSS. Therefore, I continued to prompt student thinking by asking, “What do you see teachers using to guide their instruction in classrooms today?” and “How could you find out if these standards will require teachers to change what and how they teach?” This led students to propose chapters that compare the NGSS to other science-education documents.

Some students proposed chapters that would be nearly impossible to investigate. For example, when one student proposed to investigate if states would adopt the NGSS, I asked, “What problems might we run into if we were to try to ascertain the likelihood of adoption?” Students quickly raised the issue that such a chapter would be overly speculative rather than informative.

Once the class, with my guidance, decided on several possible chapters, we took on the task of creating a logical sequence for the chapters. During this discussion, my role was to pose questions to encourage students to notice problems with various sequences. For example, when students proposed having the first chapter devoted to curricular considerations, I asked, “Why might readers struggle to understand the curricular implications, if they don’t yet have an understanding of the content of the standards?”

*The writing process.* Students leapt into the writing process. Rarely have I witnessed students so eagerly researching, writing and discussing. At first, I roamed around student groups listening to their conversations. My initial thoughts were that although students were collecting useful information, they were struggling to give their chapters structure. In hindsight, this should not have been surprising given the difficulties students had with creating a structure for the book, as well as the lack of authentic writing experiences undergraduates typically have. Therefore, I used a few minutes of one of the first class work sessions to discuss the writing process. I posed questions such as, “Why is preparing a logical flow to your chapter so important?” and “What value might there be in creating an outline for your chapter before you begin writing?” While I had assumed students would not need such guidance, I noted that after discussing some of these basic writing processes, students’ progress on their chapters seemed to be more focused.

After some initial guidance with respect to writing, I continued to walk amongst the groups of students listening to their discussions, asking and responding to questions. For example, one group was discussing the inclusion of ideas about the nature of science in the NGSS. They wondered to what extent the nature of science had been included in previous science-education documents. I was able to recommend they investigate both the 1996 *National Science Education Standards* and the 1989 *Science for All Americans* documents. Rather than answer their questions, I worked to point the groups of students to resources. Through this strategy, I hoped to keep students inquiring and engaged with the intellectual work rather than simply adopting my views.

At the end of each work session I met with the editors and the design team. These meetings were meant for them to ask my advice as well for me to see how the project was progressing overall. During these meetings, I was able to counsel the leadership teams regarding the project itself and with respect to leadership. For example, the editorial team was having some problems with authors not responding to, or even simply deleting, the editors’ feedback on chapters. While the editors initially responded rather passive-aggressively, I recommended that the editors plan a meeting with the authors and have a clear rationale for the authors who needed to address the editors’ feedback (e.g. maintain coherence within the book). After this meeting, the collaboration between the editors and the author group was much improved.

One recommendation that came out of the leadership meetings was the need to include peer feedback. The editorial team set a deadline for rough drafts and assigned groups to provide feedback to each other. Documents were easily traded because all groups were already using Google Docs to compose their chapters. These peer-feedback sessions helped refine the chapters and helped authors understand when their writing was not clear to others.

*Assessment.* My courses make use of a standards-based grading model. Standards-based grading is a nuanced approach, and the details lie beyond the purpose of this article, but some brief thoughts about how this assignment was used for assessment and evaluation are discussed below.

Because of the standards-based approach, students' chapters were not evaluated in a traditional sense. Instead, I provided feedback on student writing designed to help them improve their final product. Oftentimes, this feedback took the form of questions posed to encourage students to continue to wrestle with their writing. For example, I might write, "To what extent will the reader be familiar with the material you've referenced?" or "How might addressing this material after you provided some context improve your readers' ability to understand your points?" While I did sometimes make more-explicit comments about content, my intent was always to help students improve their work. Importantly, I noticed that students engaged with my feedback more rigorously on this assignment than with the more traditional assignments. I believe this increased engagement with the feedback is linked to the published nature of their final product.

After students finished their chapters, their task was to identify course standards they had met through their chapter. Importantly, once students proposed to have met a standard, my task was to decide whether or not the student had, in fact, met it. If I believed the student had not, I provided explanation (written or verbal) for my decision and the student could continue working on that standard. The various content and contexts of each chapter meant that different students met different course standards with their chapters.

When evaluating the use of the book project itself, anonymous course evaluations provided the most interesting information. Most students viewed the project as a way to explore science-education ideas related to their interests. For example, one student wrote, "I enjoyed the opportunity to make connections between my endorsement and this class during the book project." Another student commented, "The book project was challenging, but really helped me apply what I learned in a new way."

That the book project was challenging for undergraduate students is not surprising. However, some students thought the project was too challenging. One student exclaimed, "Don't ever write a book again!" While this student did not explain the comment, another student provided some insight, saying, "I didn't feel like I was an authority enough to have a chapter written in a published book." Yet, despite this uncertainty, several students noted particular pride in their accomplishment. One student wrote, "I didn't think the book would turn out as good as it did." Another student, noting both the intimidation and the utility of such a project said, "I was really intimidated by the project, but after spending so much time reading about my topic, I feel more prepared to implement the new standards." While I recognise the daunting challenge that writing a book presents, I plan to continue this project in future semesters to help students to think more deeply about course concepts and to encourage them to investigate aspects of science education related to their career goals.

## Discussion

Testing the applicability of AIW in a tertiary context is an important consideration for projects such as these. In other words, the instructor has to consider whether the skills learned in the project are transferable outside of the classroom context. While the students discussed in this article often focused more on the product or outcome (the finished book), we knew as instructors that the critical learning occurred in the processes (construction of knowledge and disciplined inquiry) that led to the final product. The students' perception was that for this project, the stakes – a published book on the open market – were higher than those for other classroom assignments. To that end, students quickly understood that the content must be original and insightful and that a disciplined, reflexive approach, supported by peer review and collaboration, was critical to the process.

These projects took weeks, not hours, to complete, and students invested significant amounts of time and intellectual resources. They identified their own tasks and sub-tasks, each in a unique and personal way, to move toward the major task. They had to examine their task from a variety of theoretical and practical perspectives, as opposed to a single teacher-prescribed perspective.

Whether it is the task of interpreting newly created science standards for classroom pedagogical consideration or writing a dissertation to complete a doctorate degree, the skills embedded in these projects will assist students in similar tasks outside of our classrooms. The authenticity of these projects allow students to make decisions and reflect upon both the process and the product at the individual and group level.

Sometimes instructors are not comfortable with giving away the positional power in a classroom setting. We have found that when the students, both graduate and undergraduate, are drivers in the design of the process and content in a problem-solving or investigation process with implications beyond the classroom, the end product will be of greater quality and will provide more engagement for the students. Yet, execution of these projects is daunting. One framework that helped guide our thinking is the work of Barron et al. (1998). These authors identified four design principles that “lead to doing with understanding rather than doing for the sake of doing” (Barron et al. 1998, p.273):

- Learning-appropriate goals,
- Scaffolds that support both student and teacher learning,
- Frequent opportunities for formative self-assessment and revision and
- Social organisations that promote participation and result in a sense of agency.

As noted above, we worked to identify and help students clarify the goals of their project. We worked to scaffold student work by serving as sounding boards and resources, and occasionally by providing direct guidance throughout the project. While formative assessment made intuitive sense given the nature of the book project, we found the formative self- and peer-assessments to be of tremendous value for improving the quality of our students' work. Because the books represented the work of all students, collaboration was embedded throughout the processes. Finally, because the books were published in the open market, the students came to see how their voice could serve an important role in the greater discourse around their topics.

While Barron et al. (1998) have provided general design principles, Grant (2002) provides some additional detail-oriented suggestions. For example, he suggests that instructors assist the process by facilitating certain steps for implementation in the classroom. He suggests an introduction

phase to anchor the activity, followed by the creation of a guiding or driving question that will lead the process/investigation that is to result in one or more sharable artifacts. As instructors, we were prepared to suggest resources that would assist the endeavor and provide scaffolding as each student navigated possible ways through the process. We also were constantly looking for opportunities where students could collaborate in teams and review each other's work. In the end, it was our job to provide opportunities for reflection and transfer through debriefing sessions, journal and blog entries and extension activities (Grant 2002).

One of the informal mantras that we used throughout our PBL/AIW experience was "the student who does the work learns from the work". To complete the project, students gathered information from a variety of sources and synthesised it, analysed it and derived knowledge from it. In this methodology, learners turned into active problem-solvers on the projects, rather than passive receivers of knowledge (Gulbahar & Tinmaz 2006). In the end, students demonstrated their newly acquired knowledge and were assessed by how much they had learned, the transferability of that knowledge and how well they communicated it.

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