Secondary Research on Active Learning: Theory, Research and Practice

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アクティブ・ラーニングに関する文献検索リサーチ：理論、研究、実践

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1. Introduction

In recent years student-centered active learning has received considerable attention in tertiary education. Calls for educational reform and alternative approaches to traditional instruction have led many proponents of active learning to advocate for its effectiveness. Supporters argue that students who are more actively engaged in their learning process, as opposed to passive recipients of information, will be more likely to obtain meaningful understanding of required content. Conversely, skeptics view active learning as just another pedagogical trend sure to take its place among the other obsolete relics of pedagogy (Prince 2004).

The purpose of this article is to review the most relevant theoretical and empirical data on active learning approaches. First, some of the more commonly used practices from a wide range of active learning approaches are briefly identified and defined. Second, a variety of educational theories and research highlighting the effectiveness of active learning approaches in increasing academic achievement are also presented. Briefly mentioned are other pertinent findings in the literature related to education, e.g.,
student attitude, motivation etc. Third, three pedagogical practices are introduced, each of which serves as an alternative to, or allows modification of, traditional approaches. Finally, common barriers to an active learning approach are identified.

2. Active learning: Definitions

Active learning can be quite simply defined as students doing something meaningful and thinking about what it is they are doing (Bonwell and Eison, 1991). At its heart are the notions of student-centeredness – as opposed to teacher-centeredness – and the active and personalized engagement of learners in the learning process. Prince (2004), identifies two core elements in active learning: “student activity” and “engagement in the learning process” (p. 1). He notes that although homework and out of class study would be considered active, active learning generally refers to activities done inside the classroom. Active learning is, however, an umbrella term for a wide range of more specific approaches and methodologies: cooperative, collaborative, and small-group learning; problem-based learning; discovery learning; conceptual mapping; and role-plays and drama. These are just a few of the many ways in which active learning materializes in the classroom.

One common thread running throughout active learning approaches is the use of small-group work. Placing students into small cooperative groups gives them a chance to work toward a common goal while building interpersonal and problem solving skills. A review of the relevant literature reveals that small-group work is a practice widely used by experienced active learning practitioners (Johnson, Johnson & Smith, 1998; Springer, Stanne & Donovan, 1999; Prince, 2004; Michael, 2006; Lujan & DiCarlo, 2005). Here we will more clearly define two forms of small-group work: cooperative and collaborative learning, as these approaches are referred to throughout this article.

Cooperative learning as defined by Prince (2004) is “a structured form of group work where students pursue common goals while being assessed individually” (p.1). Springer, St anne and Donovan (1999) find it helpful to compare cooperative learning with competitive learning and cite numerous meta-analyses (Johnson & Johnson, 1989, Johnson, Johnson & Smith 1991a, 1991b; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Qin, Johnson & Johnson, 1995) contrasting these opposing learning environments. They note consistently “favorable effects [of cooperative learning] on achievement and productivity, psychological health and self-esteem, intergroup attitudes, and attitudes toward learning” (p. 23). Johnson, Johnson and Smith (1998) cite social interdependence theory, the view that the ways in which groups are structured, e.g., cooperatively versus competitively, determines “how individuals will interact, which in turn determines outcomes” (p. 29). The structured nature of cooperative learning, in which the instructor places parameters on activity and assigns roles to group members, contrasts with another form of small-group learning: collaborative learning.
Collaborative learning can be defined as the “relatively unstructured processes through which participants negotiate goals, define problems, develop procedures, and produce socially constructed knowledge in small groups” (Springer et al. 1999, p. 24). This approach differs from cooperative learning as learners are tasked with more autonomous responsibilities regarding the interactions they face. Prince (2004) points out that one of the core tenets of collaborative learning is the unstructured interaction between students, as opposed to individuals learning in isolation. It is this unstructured nature of these interactions that supporters argue is the greatest value. Cohen (as cited by Springer et al., 1999) has noted that the cognitive growth of learners engaged in overly structured activities is impeded by the fact that students do not engage in the types of interactions, e.g., debates, discussions, presentations to peers etc. that facilitate higher-order processing, i.e., analyzing, synthesizing and applying new information. Cooperative learning theorists by contrast, such as Johnson et al. (1998), hold that it is the structure set up by an instructor that gives students the practical and interpersonal skills needed to engage effectively in the sorts of interactions which forge deeper understanding of concepts.

Whichever form of active small group learning one chooses to use in the classroom, both have clear advantages over a strictly traditional classroom when building the skills needed for academic achievement. Just how much more effective active learning is compared to traditional methods when it comes to learning should be investigated further.

3. Theory and Research

Michael (2006) illustrates several key principles associated with all forms of learning. One of those principles is that “[i]ndividuals are likely to learn more when they learn with others than when they learn alone” (Michael, 2006, p. 161), and research tends to bear this out. Springer et al. (1999) found that science, math, engineering and technology (SMET) students who engaged in small-group work, i.e., cooperative, collaborative, or mixed-group learning, demonstrated significantly higher levels of academic achievement. The effect reported in their meta-analysis suggested that individuals working in small-groups, as opposed to individually, showed a significant jump from the 50th to the 70th percentile, over half a letter grade. In the same meta-analysis, Springer et al. (1999) noted more favorable student attitudes when students worked cooperatively, as well as a 22% decrease in attrition rates among SMET students. These findings are consistent with a number of other studies including a meta-analysis by Johnson et al. (1998) comparing cooperative active learning to competitive traditional approaches. This analysis showed a significant increase in academic achievement as well as social, psychological and affective well-being. The authors’ observation regarding student positive attitudes, however, was not found to be consistent with a later study by Smith and Cardaciotto (2011), which noted that freshman psychology students’
self-reported less than positive reactions to active learning conditions. The authors suspected that even though students were reported to have both higher levels of retention and to be more engaged with course materials, they may have “resented the intellectual effort necessary for successful completion of the activities” (p. 58). The authors concluded by stating that despite some less than favorable reactions, the benefits outweighed the costs and instructors should find ways to actively engage learners in the material despite these reactions.

In another robust study on interactive-engagement vs. traditional methods, Hake (1998) used a sample size of over 6000 students from introductory physics courses to investigate the effects of active learning on conceptual and problem-solving tests. Hake noted that students engaged in high levels of interactive-engagement, versus those in traditional courses, had improved average gains of nearly two standard deviations (1998). This translates to tests scores “roughly twice as high in classes promoting engagement than in traditional courses” (Prince 2004, p. 4). Does this mean that all forms of processing and knowledge are equally advanced through interactive learning?

In a study conducted by Linton, Farmer and Peterson (2014), the authors found that following a 10-15 minute lecture students working in cooperative groups scored no higher on the multiple choice sections of the exam than those working individually. They also noted no significant effects on levels of self-efficacy from peer interaction. The authors suggest that low-level memorization of content, like the kinds of items found on many multiple-choice, cloze tests and true/false assessments, is achieved just as effectively working as individuals as with peer interaction (Linton et al. 2014). These findings support the hypothesis of Johnson and Johnson (as cited by Linton et al., 2014) that individual work may yield the best results when “[u]nitary, nondivisible, simple tasks need to be completed, such as the learning of specific facts or the acquisition or performance of simple skills” (p. 251). In the same study, however, Linton et al. (2014) did note that there were significant differences in performance related to essay questions between the two groups. Students working in cooperative groups consistently and accurately included more content-related concepts on all essay questions. This, according to the authors, suggests that the advantages of active learning, and in particular cooperative small group learning, may be best observed in higher-level processes such as the synthesizing and application of new information.

At the core of the educational advantages addressed above include varying levels of student interaction encouraging active cognitive elaboration – usually through the form of some small-group work. However, small group work is not the only active learning method that can achieve higher-order learning. In a recent study conducted by Linton, Pangle, Wyatt, Powell and Sherwood (2014), the authors wanted to identify whether there were differences between the student scores of those engaged in discussion only (DO), writing only (WO) or discussion with a
writing component (DW). They found that while there were no significant differences between WO and DW groups, both writing groups scored significantly higher than the DO group. The authors suggest that writing, a form of non-group active learning, leads to greater understanding as students are forced to better process, organize and present information.

4. Implications for teaching

There are a number of low-risk ways in which a teacher can transition from a traditional teaching style to one that incorporates active learning principles. In a lengthy monograph by Bonwell and Eison (1991) the authors recognized both the merits and shortcomings of the traditional lecture and offered a variety of ways that the traditional lecture can be modified to encourage more active engagement with the material.

4.1 Short lecture pauses

One such suggestion was to simply pause intermittently throughout the lecture to give students time to have brief content-related discussions with peers, compare notes, and more fully process the lecture content (Bonwell and Eison, 1991). The benefits of these short lecture pauses are based on what researchers have discovered in a number of studies (Stuart and Rutherford, as cited in Bonwell and Eison 1991; Hartey and Davies cited in Prince, 2004) regarding the rapidly diminishing attention span and retention of material after the first 15-20 minutes of a lecture. Short lecture pauses have been found to offset this rapid decline in attention by breaking up the lecture into 15-20 minute mini-lectures, followed by 2-minute pauses in which students share and compare notes. Ruhl, Hughes and Schloss (1987) found that learners that engaged in short lecture pauses versus those in straight lecture had significantly higher short-term recall and long-term retention of material and scored significantly higher on assessments measuring content knowledge. These pauses may aid in learning as they combat diminishing attention span by allowing students to reset and refocus several times within one lecture.

4.2 Minute papers

As stated above, the pause procedure gives students a chance to reset and refocus attention, but it also gives them a chance to identify any misconceptions they may have by sharing and comparing notes with a peer. Another way that an instructor can achieve this on an individual level and enhance the traditional lecture is by incorporating what Barbara Lom (2012) calls “minute papers” (p.69). Minute papers are very short writing assignments typically given at the end of a lecture asking students to answer a simple prompt about the content covered in that day's lecture. These short writing exercises, the author suggests, can provide valuable insight for both teachers and students as to the gaps in understanding and the areas that may deserve
more attention in follow-up lectures. Minute writing provides students with an opportunity to analyze, synthesize and elaborate through writing, which has been noted above by Linton et al. (2014) to promote the development of higher-order processes. When explicitly coupled with specific learning objectives and content, these short writings serve as an active way for individuals to deepen understanding through accommodating and assimilating new information. Furthermore, these papers, if assigned point values, say for in class participation or attendance, can serve as incentives for students to attend class and actively engage with materials being covered (Lom 2012).

### 4.3 The flipped classroom

Pause procedures and minute papers are simple “low-risk” ways that a teacher otherwise not trained or experienced in active learning can incorporate active learning approaches into a traditional classroom. A final practice becoming increasingly popular in recent years, which is admittedly more involved or “high-risk”, is the inverted or “flipped” classroom. The idea behind the flipped classroom is to use time outside of class, through online sources, e.g., Youtube, Ted Talks, Edmoto, Khan Academy etc., and textbooks and supplemental reading, to cover course content, while using in-class time for activities, peer teaching and lectures covering concepts that students (recorded through quizzes and short writings) are struggling with.

While initial teacher workload is cited as an obvious concern (Bates & Galloway, 2012), the advantages of this active learning practice is that it uses valuable in class time for addressing the specific needs of students – as opposed to trying to cover all content equally – while keeping students engaged with material both inside and outside of class. Bates and Galloway (2012) have reported resounding success using the inverted classroom with respects to student participation, efficient use of lecture time, and academic achievement in a large (around 200 students) introductory physics course.

### 5. Barriers

Diverging from traditional practices, namely the teacher-centered lecture, may appear to pose considerable risk to inexperienced teachers who remain skeptical of the benefits. Lack of experience and risk are, however, only two of the barriers identified by researchers, instructors and students when implementing active learning in the classroom. Michael (2007) and Miller and Metz (2014) have provided insightful summaries of perceived barriers to active learning as reported by teachers and students. They have also provided some solutions for navigating around them.

A commonly held belief by instructors is that, given the amount of material that must be covered over the length of a course, there is simply not enough time to incorporate active learning into the lecture. Miller and Metz (2014) note, however, that this perception is based on the idea that lecture-content is actually learned. Research by
Edgar (cited in Miller & Metz 2014), which states, “after 2[weeks], students tend to remember 20% of what they hear and 90% of what they say and do” (p. 251). They point out that the reason the traditional lecture is favored is that it is believed to be the most efficient use of time for covering all material. But alternative methods, such as the inverted classroom mentioned above, are more likely to yield greater learning benefit and free up time for in class activities, thereby promoting more engaging processes such as discussion, debate, peer teaching and collaborative projects. The lecture, though time efficient, appears to have diminishing returns in terms of learning outcomes.

Another barrier perceived by faculty, also noted by Miller and Metz (2014), is that instructors are not properly trained to implement active learning and that there is a lack of incentive and support by administration to learn alternative methods. Michael (2007) notes that all too often, even where faculty development is supported by administration, these efforts are often ineffectual at producing lasting changes in the classroom. Some cited reasons for this are that teachers receive only brief introduction to new teaching ideas with little or no follow-up, and that teachers often abandon efforts to implement change at the first sign of problems in the classroom (Michael, 2007). The solution appears to be found in administrative support and incentives for instructors making efforts to adopt the alternative methods championed by reformers, as well as an open dialogue among faculty on the merits of specific practices.

Finally, there is the common perception among instructors that students react unfavorably to active learning because they do not know how to do it (Michael 2007). As mentioned above, research by Smith and Cardaciotto (2011) has revealed student dissatisfaction with active learning that may be due to the “intellectual effort” that it incurred (p.58). Still, it appears that the benefits to learning and the development of higher-order processing far outweigh any initial negative feelings. In fact, it is this resented “intellectual effort” that is more than likely developing these desirable learning outcomes.

6. Summary and Conclusion

The aim of this article was to bring to light what the literature says about the effectiveness of active learning. While the results of the research covered in this article may vary, it is clear that there is much evidence supporting the effectiveness of active learning in the development of higher order processes. Engaged participation, where students work cooperatively to solve problems and interact with the information, consistently leads to greater learning gains and achievement academic achievement. Although there is no one-size-fits-all pedagogical solution to meet all learning contexts, teachers who adapt and use principles of active learning in their classrooms are sure to see its benefits.

To more fully understand the effects that specific active learning approaches have on learning and to identify clear correlates between educational practices and learning outcomes, more research,
both primary and secondary, is needed. Many researchers (Michael 2007; Linton 2014; Prince 2004) have rightly suggested that teaching practices should be based on the evidence that they are in fact effectual, and that the results of educational research on active learning should be readily disseminated among practicing teachers.

The active learning practices selected for use depend on specific teaching contexts and the level of risk an instructor is willing to take. Low-risk strategies in which the traditional lecture is modified rather than wholly abandoned offer the most realistic transitions into active learning for new initiates.

Lastly, the many barriers that prevent teachers from adopting active learning as an effective alternative to traditional methods should be navigated through administrative support, training and creating incentive for teachers’ efforts. While the concerns many instructors hold regarding the practicalities of active learning are legitimate, they can be addressed and systematically alleviated so that the countless learning benefits may reach their students.

References
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