Facilitating Student Learning Through Contextualization

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Abstract

This paper is a literature review that explores the nature and effectiveness of contextualization as a way to improve outcomes for academically underprepared college students. Two forms of contextualization have been studied: "contextualized" and "integrated" instruction. There is more descriptive work on the contextualization of basic skills than studies with student outcome data. In addition, many studies with quantitative evidence on the effectiveness of contextualization have methodological flaws that limit conclusions. Further, only a small number of studies are with college students. However, despite these problems, contextualization seems to be a promising direction for accelerating the progress of academically underprepared college students. The method of contextualization is grounded in a conceptual framework relating to the transfer of skill and student motivation; practitioners who use it observe positive results, and the available quantitative evidence indicates that it has the potential to increase achievement.

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1. Introduction

Skills in reading, writing, and mathematics are key to academic learning, but conventionally, these skills are taught separately from the discipline areas to which they must be applied. For example, students may be taught writing skills in the morning in an English course and then be expected to apply them to writing an essay in a history class in the afternoon. Several problems arise with this structure. First, for reasons still to be determined (Barnett & Ceci, 2002), students do not necessarily transfer their morning writing skills to the afternoon history assignment. Second, students may not be motivated to learn writing skills in the English class because they do not consider such skills to be relevant to their personal goals (Cavazos, Johnson, & Sparrow, 2010). Third, weaknesses in essay-writing skills may not be addressed by the afternoon content-area teacher, who aims to teach subject knowledge rather than basic skills (Fisher & Ivy, 2005).

These problems have serious implications for the academic trajectory of the many underprepared students who enter postsecondary education. Despite the allocation of considerable resources to providing developmental education courses that intend to bring the reading, writing, and math skills of underprepared students to the college level (Boylan, Bliss, & Bonham, 1997), many students in college-credit courses display continuing difficulties in applying these foundational skills to the learning of subject matter (Perin & Charron, 2006). A growing literature, especially in the field of adolescent literacy, suggests that bringing basic skills and subject-area instruction closer together may be a solution to this problem (Heller & Greenleaf, 2007; Lee & Spratley, 2010). One way to create this relationship is through *contextualization*, or the teaching of basic skills in the context of disciplinary topic areas.

Postsecondary developmental educators have recommended that pre-college academic skills instruction be directly related to the content of college-level courses (Simpson, Hynd, Nist, & Burrell, 1997). Contextualization, which achieves this purpose, can be seen as a form of "deep learning" that comes about through linking ideas and concepts across courses (Moltz, 2010). For example, Simpson et al. (1997) suggested that instruction to improve outcomes for low-skilled college students "would probably use authentic materials like the textbooks used in college courses such as psychology or

biology" (p. 41). Drawing on research on the transfer of learning, Simpson et al. (1997) contrasted such "embedded" instruction with the predominant "generic" instruction (Simpson et al., 1997, p. 42), where technical aspects of literacy or math are taught apart from content, such as when students are taught to analyze text structure or find main ideas using short reading passages that have no obvious relation to each other, to content-area courses, or to students' goals. In the generic writing approach, language is fragmented into decontextualized segments such as sentence- and paragraph-writing skills, with no connection to authentic uses. Accordingly, generic instruction has been criticized as uninteresting and ineffective (Grubb, 1999).

The purpose of this review is to consider the hypothesis that low-skilled students can learn more effectively and advance to college-level programs more readily through contextualization of basic skills instruction. The review begins with an overview of definitions and uses of contextualization. Then, two major forms of contextualization are presented, and mechanisms by which it benefits students are suggested. Evidence for the effectiveness of contextualization is then discussed in order to determine what is known about possible advantages for low-skilled students. The review ends by discussing practical implications and future directions for research on the relation between contextualization and academic outcomes for low-skilled college students.

2. Definitions, Examples, and Extent of Use of Contextualization

As E. Baker, Hope, and Karandjeff (2009) point out, contextualization has been defined in numerous ways. Here, I follow the definition proposed by Mazzeo, Rab, and Alssid (2003):

> A diverse family of instructional strategies designed to more seamlessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a specific context that is of interest to the student. (Mazzeo et al., 2003, pp. 3–4)

Of interest to many students is completing course work that counts toward a college credential. The content of this course work can serve as a context for teaching

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basic academic skills. Thus, the contextualization of basic skills is defined here as an instructional approach that creates explicit connections between the teaching of reading, writing, or math on one hand, and instruction in a discipline area on the other, as, for example, when writing skills are taught with direct reference to topics covered in a history class.

Many terms have been used to refer to contextualization, including contextual teaching and learning (E. Baker et al., 2009; Johnson, 2002), contextualized instruction (Parr, Edwards, & Leising, 2008; Wisely, 2009), content-area literacy (McKenna & Robinson, 2009), embedded instruction (Simpson et al., 1997), writing-to-learn (Klein, 1999), integrative curriculum (Dowden, 2007), situated cognition (Stone, Alfeld, Pearson, Lewis, & Jensen, 2006), theme-based instruction (Dirkx & Prenger, 1997), anchored instruction (Bottge, Rueda, Serlin, Hung, & Jung, 2007), curriculum integration (Badway & Grubb, 1997), academic-occupation integration (Grubb & Kraskouskas, 1992; Perin, 2001), infused instruction (Badway & Grubb, 1997; Perin, 2001), developmental education learning communities (Weiss, Visher, & Wathington, 2010), workplace literacy (Mikulecky & Lloyd, 1997), and functional context education (Sticht, 2005).

Whatever term is used, the work tends to converge on several key themes: teaching skills with direct reference to real world events and practices (Berns & Erickson, 2001; Carrigan, n.d.; Dirkx & Prenger, 1997; Fuchs & Fuchs, 2001; Goldman & Hasselbring, 1997; Johnson, 2002; Jurmo, 2004; Karweit, 1998; Orpwood, Schollen, Marinelli-Henriques, & Assiri, 2010; Sticht, 2005; Stone et al., 2006; Weinbaum & Rogers, 1995); and instruction in the basic skills needed in content courses (Boroch et al., 2007; Martino, Norris, & Hoffman, 2001; Perin, Hare, Peverly, & Mason, 2010; Snyder, 2002; Wisely, 2009). In some cases, contextualization occurs through the merging of basic skills and subject-area instruction (Grubb, 1996; Guthrie, Anderson, Alao, & Rinehart, 1999; Paquette & Kaufman, 2008). Further, the connection between basic skills and disciplinary learning is also seen in the newly developed national literacy standards for career and college readiness, which specify competencies for reading and writing in history, social studies, and science (National Governors' Association & Council of Chief State School Officers, 2010).

Instruction that contextualizes basic skills is often associated with career and technical education (Association for Career and Technical Education, 2010; Kalchik & Oertle, 2010), and since 1985 it has been written into the Carl Perkins Vocational Education Act, which is legislation governing secondary vocational programs (Stone et al., 2006). Various occupational areas have been used as a context for basic skills instruction such as marketing courses in high school and college career and technical education (CTE) (Artis, 2008; Berns & Erickson, 2001), and college automotive and wind technology certificate programs (E. Baker et al., 2009; California Community Colleges, 2008). However, contextualization is also found in academic programs in elementary, secondary, and undergraduate college education (Caverly, Nicholson, & Radcliffe, 2004; Misulis, 2009; Tilson, Castek, & Goss, 2010).

2.1 Components of Contextualization

In any one program, contextualization of basic skills instruction contains one or more of the following components: interdisciplinary learning (Berns & Erickson, 2001; National Council for Workforce Education & Jobs for the Future, 2010), use of students' informal, out-of-school knowledge (Goldman & Hasselbring, 1997), active, student-centered learning (Dirkx & Prenger, 1997; Dowden, 2007), student collaboration (Johnson, 2002), use of explicit literacy strategies (Paquette & Kaufman, 2008), authentic assessment (Johnson, 2002), and teacher collaboration to identify real world examples (Orpwood et al., 2010). Professional development may be given (Stone et al., 2006) but seems rare. Guidelines for contextualization have been provided for workplace and transition programs (Kalchik & Oertle, 2010; National Council for Workforce Education & Jobs for the Future, 2010), and instructions for integrating literacy instruction in high school science courses have also been offered (Krajcik & Sutherland, 2010).

Workplace literacy focuses on a broader range of skill than do other forms of contextualization; oral language, problem solving, teamwork, research skills, and basic computer operations are taught in addition to reading, writing, and math (Jurmo, 2004). Some programs have a vocational English language component where oral language is taught to English language learners using the content of specific jobs for which they are preparing (Mazzeo et al., 2003).

2.2 Examples of Contextualization

Contextualization is implemented using many different instructional techniques, and over the years a fairly large number of program descriptions have accumulated, although many are not accompanied by student outcome data. The following examples illustrate the range of approaches. In high school CTE, plumbing content was the basis of instruction in an English course (Darvin, 2000). Community college allied health and criminal justice students learned to write documentation relevant to their respective fields (Perin & Charron, 2006). Also in a community college, allied health students in a developmental math course learned to solve math problems drawn from curricula in respiratory therapy, radiology, occupational therapy, medical laboratory, physical therapy, and nursing courses they were or would be taking (Shore, Shore, & Boggs, 2004). A learning community linked literature, criminal justice, and business courses (Badway & Grubb, 1997) while another one linked developmental English and psychology courses such that writing was taught using material from the psychology course (Cargill & Kalikoff, 2007). In two studies, developmental education and middle school students worked collaboratively to create "publishing companies" in order to share their writing or math products (Goode, 2000; Reilly & Pagnucci, 2007). Students' informal, out-of-school knowledge was used to teach middle school pre-algebra by organizing the class around a project centered on a fictitious pizza company (Brenner, 2002). Developmental education courses in a learning community utilized content from a service learning experience, or paired English instruction and college success courses using the theme of African American culture, literature, and experience (E. Baker et al., 2009). In a final example, service learning in local organizations was used as an instructional foundation across the whole curriculum in a high school serving Native Hawaiian students (Yamauchi, 2003).

2.3 Contextualization Beyond Basic Skills

Our focus is the contextualization of basic reading, writing, and math skills, but it should be mentioned that contextualization is also used in discipline area instruction without a basic skills dimension. In this iteration, content area teachers contextualize instruction by referring to authentic practices related to the topics being taught in order to

deepen domain knowledge (Baldwin, 2003; Biermann & Sarinsky, 1993; Cammarata, 2009; Chaplin & Manske, 2005; Craig, 2006; Englert, 2009; Englert et al., 1995; Keselman, Kaufman, Kramer, & Patel, 2007; Macaulay, Van Damme, & Walker, 2009; Nikitina, 2006; Nokes, Dole, & Hacker, 2007; Rivet & Krajcik, 2008; Schultz, 2003; Wooden, 2008). For example, studies have been conducted to teach high school history students to think like historians by learning about the social, cultural, and economic environment in which a primary document was written (Nokes et al., 2007), or to teach science to community college science students by having them conduct and interpret experiments employing methods used by professional scientists (Biermann & Sarinsky, 1993).

In a related manner, problem-based learning situates the learning of content in authentic, everyday life situations (Barron et al., 1998).[1] Writing-across-the-curriculum and writing-to-learn, in which teachers assign writing tasks in order to enhance subject-area knowledge (Klein & Samuels, 2010), are another type of contextualization. These approaches are not intended to meet the needs of low-skilled learners in particular, and in fact, their benefits may be greater for higher-achieving students. For example, to benefit from writing-to-learn, the writing process must be proficient, which by definition is not the case with most low-skilled students.[2]

Contextualization is also used in the teaching of oral language skills to English language learners where course work and everyday life practices are the simultaneous focus of instruction (Crandall, 1993; Mak & Coniam, 2008). Contextualized approaches have also been used within teacher education to prepare pre-service teachers to integrate literacy into content area instruction (Marri et al., in press; Perin et al., 2009) and to increase their sensitivity to their students' real life situations (Darling-Hammond & Snyder, 2000; Pugach, Longwell-Grice, Ford, & Surma, 2008). Another version of contextualization is found in "situated learning," which conceptualizes education as a

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[1] Problem-based learning generally does not set out to teach basic skills. However, the term problem-based learning was used by Shore et al. (2004) to describe contextualized math instruction described below.
[2] Sometimes students are taught writing skills prior to receiving writing assignments in a discipline area. For example, Klein and Samuels (2010) taught middle school students to write persuasive essays using generic materials for four months, and then, when the writing instruction was finished, assigned persuasive essays on a science topic to investigate whether engaging in the writing task itself furthered the content knowledge. Since writing-to-learn does not embed writing instruction in a discipline area, it is not classified here as contextualization of basic skills instruction.

network of social interactions that form the basis of knowledge and skill (Anderson, Reder, & Simon, 1996).[3] Having noted these other uses, we return to the current concern, the contextualization of basic skills instruction.

2.4 Extent of Contextualization of Basic Skills

The extant literature does not provide information on the frequency of use of contextualization of basic skills instruction, but it appears that the approach is used more often in elementary, secondary, and adult literacy education than in college programs. A study of contextualization in credit-bearing vocational courses in community colleges in one state found very few examples, and those found were almost exclusively in math (Wisely, 2009). A broader search for postsecondary contextualization in the form of academic-integration in community colleges in multiple states found similar low usage (Perin, 2001). One reason may be cost: Jenkins, Zeidenberg, and Kienzl (2009) reported that an adult basic education program used in community colleges across the state of Washington receives 75 percent more funds per student than for students in traditional basic skills courses.[4]

3. Two Forms of Contextualization of Basic Skills Instruction

Perusal of the ways in which contextualization is implemented reveals that it occurs in two distinct forms: *contextualized* and *integrated* instruction. This distinction has not been made explicitly in previous literature, but it is an important contrast because each form involves different teaching staff and instructional emphases. Contextualized instruction would be employed by instructors of reading, writing,[5] and math, while integrated instruction would be the province of discipline-area instructors in both academic and career and technical areas. To maintain consistency with previous

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[3] The term "situated learning" is used in various ways in the literature. For example, Guthrie et al. (1999) use the term to refer to the integration of reading and content-area instruction.
[4] The literature search for this review did not identify any other information about the cost of contextualization of basic skills instruction.
[5] Reading and writing includes English language arts, developmental reading, developmental writing, college English, and freshman composition.

literature, the umbrella term "contextualization" is used here to refer collectively to the two forms of instruction.

Contextualized basic skills instruction involves the teaching of academic skills against a backdrop of specific subject matter to which such skills need to be applied, such as philosophy (Snyder, 2002), statistical process control (E. Baker et al., 2009), allied health (Shore et al., 2004), history (De La Paz, 2005) and earth science (Bulgren, Marquis, Lenz, Schumaker, & Deshler, 2009). The primary emphasis of contextualized basic skills instruction is the teaching of reading, writing, or math, and, as mentioned above, the instruction is delivered by developmental education, English, and math teachers. The primary instructional objective is to teach academic skills rather than the subject matter, although there may be some implicit content learning as students are exposed to subject-area material in the course of practicing basic skills. Workplace literacy programs (e.g., Mikulecky & Lloyd, 1997) provide contextualized basic skills instruction. Here, reading, writing, or math is taught in the context of job documents and tasks. Another example is instruction in a secondary English language arts class on the procedures for writing a persuasive essay on topics being taught in a concurrent history class (De La Paz, 2005). The latter model is also used in learning communities that pair developmental education with, for example, sociology, psychology, business, or student orientation courses (Weiss et al., 2010).

In contrast, *integrated basic skills instruction* is the incorporation of reading, writing, or math instruction into the teaching of content, such as in secondary social studies (De La Paz & Felton, 2010; Massey & Heafner, 2004; Nokes, 2008), elementary and secondary science (Barton, Heidema, & Jordan, 2002; Bulgren et al., 2009; McDermott, 2010; Tilson et al., 2010),[6] and college-level courses in marketing (Artis, 2008) or agricultural technology (Parr et al., 2008). For example, using integrated instruction, a high school science teacher can teach students strategies for comprehending information depicted in graphics, or how to write an argument showing why evidence supports one conclusion rather than another on a scientific issue (Krajcik & Sutherland,

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[6] The integration of reading or writing instruction in secondary disciplinary courses is known as content area instruction.

2010).[7] Integration is also seen when a community college career and technical course instructor teaches students how to write a summary of a business text or when an allied health instructor teaches students how to write log entries on patient care (Badway & Grubb, 1997; Perin, 2001). While contextualized instruction is provided by language arts and literacy teachers, integrated instruction is found in discipline-area classrooms, with the academic skills serving as a means of developing critical thinking about disciplinary content (Pearson, Moje, & Greenleaf, 2010).

Integrated instruction may also be needed when a content instructor observes that many students are having difficulty with the basic skills needed to learn the material, such as, in one example, when teachers "sneak in" reading comprehension strategies in a college course on symbolic logic (Higbee, Lundell, & Arendale, 2005, p. 328). Other types of integrated instruction are the use of "content enhancement routines" in secondary content instruction (Bulgren et al., 2009; Deshler, 2007; Sencibaugh, 2008), where a variety of techniques are used to support reading comprehension, including advanced organizers, charts that visually depict and organize information in text, mnemonic devices, and peer collaboration.

Integrating basic skills instruction involves providing explicit instruction in strategies for reading, writing, and math in discipline-area classrooms. Content teachers routinely assign reading, writing, or math tasks; what is different about integrated basic skills instruction is that the teacher provides procedural knowledge, i.e. tells the students how to perform these tasks using modeling techniques (e.g., Vaughn et al., 2009) rather than merely assigning them. The integration of reading, writing, and math skills is relatively easy to accomplish in elementary school classrooms since one teacher teaches all subjects. For instance, the writing skills of fifth and sixth grade students improved when teachers provided explicit strategy instruction in argumentative writing as part of social studies and science lessons (Klein & Kirkpatrick, 2010). Complications for integrating basic skills into content area instruction come in secondary education, where teachers specialize in subject areas. In this case, content-area teachers need to be

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[7] However, although content area literacy preparation is a staple of secondary teacher education programs, the integration of instruction in basic skills in content classrooms has not become the norm (Perin et al., 2009).

persuaded of the value of integrated instruction and be provided with professional development in appropriate techniques.

3.1 Commonalities in the Two Forms of Contextualization

Academic skills and subject-area teachers may collaborate to plan instruction in both contextualized and integrated instruction (E. Baker et al., 2009; Berns & Erickson, 2001; Jenkins, Zeidenberg, & Kienzl, 2009), and both approaches may be used within learning communities (Cargill & Kalikoff, 2007). In addition, "hybrid" courses that combine basic skills and career content in equal measure have also been described (Badway & Grubb, 1997; Grubb & Kraskouskas, 1992; Perin, 2001; Wisely, 2009). Since these tend to be taught by content instructors (Perin, 2001), hybrid courses are considered a form of integrated instruction in the current overview. Both contextualized and integrated instruction are a departure from traditional basic skills instruction, where reading, writing, and math are taught in the abstract, with little or no reference to authentic applications (Johnson, 2002; Jurmo, 2004). Because instruction must be customized for specific contexts, both approaches can require considerable effort on the part of instructors. However, given the high incidence of difficulty with basic academic skills among many college students in the United States (Bailey, Jeong, & Cho, 2010a, 2010b; Grigg, Donahue, & Dion, 2007; Salahu-Din, Persky, & Miller, 2008), it is important to find instructional methods that can promote improved outcomes. Both forms of contextualization seem to be a promising direction for this purpose.

4. Underlying Mechanisms

The goal of contextualization is to create conditions for more effective learning, expressed for example in higher grades and rates of retention in courses, and through progression to more advanced course work. Whether instruction is contextualized or integrated, the connection of basic skills instruction to applications and life goals is consistent with constructivism, which places students' interests and needs at the center of education (Dewey, 1966; Dowden, 2007). The theoretical literature suggests that both

cognitive and affective mechanisms underlie the expected improvement in learning outcomes.

From a cognitive perspective, contextualization is thought to promote transfer of learning and improve the retention of information (Boroch et al., 2007; Carrigan, n.d.; Dirkx & Prenger, 1997; Fuchs et al., 2003; Gillespie, n.d.; Karweit, 1998; Stone et al., 2006; Weinbaum & Rogers, 1995). When information is learned in a context similar to that in which the skills will actually be needed, the application of learning to the new context may be more likely. Stone et al. (2006) hypothesized that "The creation of explicit connections between situations is critical if students are to transfer their knowledge and skills outside the classroom, whether it is to another context or to an abstract testing situation" (p. 11). However, knowing when and where one should apply a previously-learned skill requires metacognitive and self-regulation abilities that low-skilled students may lack (Bailer, 2006; Fox, 2009; Mayer & Wittrock, 1996; Nash-Ditzel, 2010). Linking basic skills in developmental education instruction directly to authentic content-area applications that students will encounter in a disciplinary course may increase the likelihood of transfer of skill to that particular setting.[8] It has been suggested that by using authentic academic texts as part of academic assistance services, low-skilled students become more active learners and are then more inclined to use their skills in college courses (Simpson & Nist, 2002).

Barnett and Ceci (2002) proposed that the extent of transfer of skill will vary according to the type of skill being targeted, how transfer is measured, the demands placed on memory of the skill to be transferred, and the distance between learning and

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[8] Cognitive theory on transfer has a long history of unresolved debates (Anderson et al., 1996; Barnett & Ceci, 2002; Billing, 2007; Bransford, Brown, & Cocking, 2000; Detterman & Sternberg, 1993; Greeno, 2009; Mikulecky, 1994; Perkins & Salomon, 1989; Smagorinsky & Smith, 1992; Son & Goldstone, 2009). One problem is the lack of a commonly agreed-upon definition of transfer (Barnett & Ceci, 2002), but a more pressing question is that of "dosage," i.e., how much contextualization is required to facilitate the transfer of learning. More specifically, the debate has focused on creating flexible learners who will apply knowledge and skill to diverse situations. It has been theorized that over-contextualization limits learners' flexibility in applying new knowledge and skills (Bransford et al., 2000). The debate has a slightly different focus from that in the current review, which is narrower in its concern with the learning and application of basic literacy and math skills by low-achieving students. From a pragmatic point of view, although too much contextualization may inhibit flexibility in the application of skills, the simple application of basic skills to a subject area would be an improvement over the current situation in which many low-skilled students do not apply the basic skills they learned once in remedial settings to the content classroom. Further, it appears that transfer is difficult to discern even when explicit instruction in transfer is provided (Hendricks, 2001).

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transfer. According to this framework, the distance between original learning and eventual transfer can be measured in terms of the similarity of the two domains, as well as the physical, temporal, functional, and social contexts, and the modality for expressing transfer. In the present context, modality is the application of a skill such as verbalizing how a math problem is solved in an accounting class or writing a summary in a history class.

In addition to the cognitive mechanism of transfer of learning, the possible benefits of contextualization may be explained by the affective mechanism of intrinsic motivation, where a learner is drawn to engage in a task because it is perceived as interesting, enjoyable, and/or useful (L. Baker & Wigfield, 1999; Becker, McElvany, & Kortenbruck, 2010; Ryan & Deci, 2000). Academically underprepared college students may not have high levels of intrinsic motivation to learn basic skills that they should have learned much earlier in their academic history (Cavazos et al., 2010; Dean & Dagostino, 2007; Gardenhire-Crooks, Collado, Martin, & Castro, 2010). The low motivation may occur because, having graduated from high school, students may not realize that their academic skills are not at college standard, so they may resist the need to sit yet again in classrooms that teach basic skills. Further, underprepared students may not be motivated to attend class regularly and apply themselves to learning because of a dislike of appearing incompetent (Dean & Dagostino, 2007) or because of competing job and family responsibilities (Caverly et al., 2004; Kozeracki, 2005).

Connecting developmental reading, writing, and math instruction directly to the content courses students must pass in order to earn a postsecondary credential may improve intrinsic motivation to learn the skills. The assumption is that students will be more engaged in the learning process if they perceive it to be useful and meaningful (Berns & Erickson, 2001; Bond, 2004; Boroch et al., 2007; Guthrie et al., 1999; Johnson, 2002; National Council for Workforce Education & Jobs for the Future, 2010; Shore et al., 2004; Sticht, 2005).[9] Similarly, workplace literacy students, who may not generally

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[9] The hypothesis here is that the level of intrinsic motivation predicts the level of future engagement in course work. However, it is noted that intrinsic motivation to read has not been found to be a statistically significant predictor of future reading ability. Rather, level of intrinsic motivation to read loses its independent predictiveness once prior reading ability is accounted for (Becker et al., 2010). The same may be true for intrinsic motivation as a predictor of students' engagement in learning, so that motivation may be confounded with prior academic achievement in predicting future course engagement.

see the appeal of basic skills instruction, may be more motivated to learn the skills when instruction is connected to immediately-useful applications (Ekkens & Winke, 2009; Jenkins et al., 2009; Sticht, Armstrong, Hickey, & Caylor, 1987; WSBCTC, 2005).

5. Evidence on Contextualization

The literature was searched for evidence on the contextualization of basic skills instruction,[10] positive or negative. Basic skills was defined as ability in reading, writing, and mathematics. Because there were few studies with college samples, it was decided to screen in research from elementary and secondary education as well. Studies were selected if they contextualized reading, writing, or math instruction and used quantitative measures of student academic outcomes. Twenty-seven studies were found, 17 on contextualized instruction, nine on integrated instruction, and one on both contextualized and integrated instruction (Wisely, 2009). These studies are summarized in Table 1 (Appendix), ordered in turn by educational sector (college, secondary, or elementary education), type of contextualization (contextualized or integrated instruction), skill area (reading, writing, or math), and alphabetical order by author name. The table and this paper are both confined to studies reporting student outcomes, although some studies, e.g. Greenleaf et al. (2010), and Stone et al. (2006), also reported findings on teachers' practice and perceptions. In Table 1, the design,[11] analysis, sample, nature of instruction, and dependent variables for the student outcomes are summarized for each study.

Quantitative studies of *contextualized instruction* were conducted with college academic programs (six studies), adult basic education (six studies), and K-12 academic education (four studies of each) but no studies were found for this form of contextualization with college or high school CTE students. Five of the six studies on contextualized instruction in college involved developmental education (Caverly et al.,

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[10] The literature search produced many examples of contextualization, but most of the work was descriptive, without supporting data on evidence. For example, E. Baker et al. (2009) described 11 different programs involving contextualization in postsecondary settings but no evidence on their effectiveness was reported.

[11] Some studies did not explicitly state whether an experimental or quasi-experimental design was used. In these cases, it is assumed that a quasi-experimental design with a comparison rather than control group was used, with the control group defined as a group created through random assignment.

2004; Perin et al., 2010; Shore et al., 2004; Snyder, 2002; Wisely, 2009) and one (Martino et al., 2001) focused on low-achieving students in a college-level content course. Among the six studies with adult basic education students, five were with workplace literacy programs (Ekkens & Winke, 2009; Lazar, Bean, & Van Horn, 1998; Mikulecky & Lloyd, 1997; Perin, 1997; Sticht, 1995) and one was with a prison sample (Dirkx & Crawford, 1993). Three of four studies of K-12 contextualized instruction focused solely on math (Bottge, 1999; Bottge & Hasselbring, 1993; Brenner et al., 1997), and one taught writing (De La Paz, 2005).

Four of the 10 studies on *integrated instruction* were with CTE programs: two in college (Cox, Bobrowski, & Spector, 2004; Jenkins et al., 2009) and two in secondary education (Parr et al., 2008; Stone et al., 2006). The other six studies were in academic programs in elementary (Guthrie et al., 1999; Tilson et al., 2010) and secondary education (Bulgren et al., 2009; De La Paz & Felton, 2010; Greenleaf et al., 2010; Vaughn et al., 2009).

Many of the studies had methodological weaknesses that limited the conclusions about the effectiveness of contextualization. Sometimes there was no control group, group assignment was through self-selection, comparison samples were not equated for pre-intervention skill levels, groups received different amounts of instruction, or there was possible contamination of treatment and comparison instruction. Some studies reported outcomes but not inferential statistics, and others used only self-report measures or researcher-designed measures, the properties of which were not reported. These flaws are indicated in Table 1. The studies that offer the best evidence[12] are summarized in the following sections.

5.1 Evidence on Contextualized Instruction

College settings. Working with developmental reading and writing students, Perin et al. (2010) contextualized reading and writing instruction in biology. Students used a curricular supplement to practice written summarization, question-generation, vocabulary, and persuasive writing skills, with a strong emphasis on summarization. The

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[12] Most of the studies of contextualization in college settings have serious limitations. However, all of the studies of contextualization in college identified in the search for this review are included in the following section because we are most concerned with this particular educational sector.

supplement consisted of 10 units, which were completed independently outside of the classroom weekly over one college semester. The reading and writing practice centered on a biology text drawn from anatomy and physiology textbooks. To address difficulties in discriminating between important and less important information in the text (Johns, 1985; Perin, Keselman, & Monopoli, 2003; Selinger, 1995), instructions in the units led students to the main ideas in the biology text prior to writing a summary.

Students in 12 developmental reading and English classrooms were randomly assigned to use the contextualized intervention or a generic version of the intervention that was identical, except that generic text from developmental education textbooks was used. A third group from a purposive sample of four classrooms served as a business-as-usual comparison group. Both intervention groups showed statistically significantly higher gain on several summarization variables (the proportion of main ideas from source text, accuracy of information, and word count) than the comparison group, and the contextualized biology group showed greater gain than the comparison group on two summarization variables (inclusion of main ideas and the accuracy of written summaries), with effect sizes of 0.33 to 0.62 SD units. However, pre-post gain on a generic, standardized test of reading was minimal, and neither intervention group showed greater gain than the comparison group on this measure. The findings for the summarization measure suggest that systematic practice contextualized in content-specific text helps students learn to summarize the type of material they need to read in order to learn in college-credit courses. At the same time, the study is limited by the fact involved independent practice rather than direct instruction, and students received only a small amount of feedback, raising the possibility that student-related variables rather than solely the intervention may explain the results. Also, since randomization occurred within classrooms, there may have been contamination between conditions.

Caverly et al. (2004)[13] investigated the use of a contextualized reading comprehension strategy with first-semester students in developmental reading classrooms in a four-year college. Instruction was anchored in chapters from textbooks used in core curriculum courses that the students would have to pass to complete their degrees. The

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[13] Two experiments were conducted using the same form of contextualization. Since only the second used a comparison group, only that study is reported here.

instruction focused on a strategy based on the mnemonic "PLAN" (Predict, Locate, Add, and Note).[14] With this strategy, students first predicted what would be in the textbook chapters, and then examined the title, introduction, subtitles, the use of boldface and italics, pictures, graphs, and summaries. From the predictions and examination of the text, the students created a concept map (visual display of the information) and ascertained how they would approach the reading task. In the next step of the strategy, students checked items in the concept that they already knew and marked unfamiliar information with a question mark. Next, student read the text and expanded the concept map using new information. In the last step of the strategy, they reflected on what they had learned and estimated how well they thought they could now satisfy the task demands they had identified before reading. To teach the strategy, the teacher modeled it using think-alouds and by providing a demonstration of metacognitive skills,[15] and the students practiced in small groups. The groups applied the strategy to both "considerate" and "inconsiderate" text, defined by how clearly it was written (McKeown, Beck, Sinatra, & Loxterman, 1992).[16] Also, to promote transfer of learning, the students were asked to apply the strategy in other classes and were required to summarize this in writing.

Outcomes for $n = 56$ students who took the contextualized reading course were compared to those of a random sample of students ($n = 72$) who had the same reading levels at pretest but did not take developmental education. Pre- and post-test levels were measured by using both a statewide standardized reading test and grades in a subsequent college-level history course with high reading demands. Statistically significantly higher scores were found for the treatment group on both measures. This study suggests that the strategy promoted achievement in college-credit courses, but conclusions are tentative because the comparison group did not take developmental education, leaving a question

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[14] Mnemonics are frequently used in literacy instruction for low-skilled students. This device is a type of scaffolding that aims to make processes in reading and writing that are characteristic of proficient reading explicit and easy to remember.

[15] Metacognitive skills include self-monitoring to check for whether what is being read is being understood, and repair strategies to improve comprehension when the reader determines that he or she is not understanding (Simpson & Nist, 2002).

[16] Many textbooks are poorly written, particularly in terms of conveying information coherently. Interactions have been found between reading ability and text coherence such that the comprehension of low-skilled readers is poorer on minimally coherent texts compared to highly coherent texts. In contrast, highly skilled readers are able to comprehend minimally coherent text by referring to their background knowledge (McNamara, Kintsch, Songer, & Kintsch, 1996).

as to whether the developmental education course in general or the strategy instruction, or a combination of the two, was responsible for the improved performance. Also, students who choose to take versus not take developmental education may differ on variables such as motivation that may explain the group difference.

Similar to Caverly et al. (2004), Shore et al. (2004) contextualized basic skills instruction in college course content. Community college developmental math students who were preparing for degrees in various health professions were taught problems based on topics from allied health (respiratory therapy, radiology, occupational therapy, medical laboratory, and physical therapy) to nursing curricula. The problems were developed collaboratively by a group of health and developmental education instructors who observed each other's classes. For example, a problem was developed to teach students to interpret a graph illustrating the relationship between percent of normal glomerular filtration as measured by creatine clearance, and blood urea nitrogen, to yield a function needed by a nurse to analyze a patient's kidney function. Data were collected for cohorts over a three year period.

Compared to a comparison group made up of sections of a traditional developmental math course, students receiving the contextualized instruction in the first two years of the study earned better math scores and were more likely to respond on a questionnaire that they found the instruction useful. The proportion of contextualized problems on the math test increased each year over the three year project period, in the third year increasing to 70%. The contextualization group participating in the third year did not show an advantage over the comparison group. The researchers attributed this change to a larger number of seriously underprepared students than in previous years and to the fact that the contextualized problems were harder than the traditional problems. Thus while the positive findings for contextualization in the first two years of the study are encouraging, firm conclusions cannot be drawn, because it was not stated how classrooms were assigned to conditions nor whether the groups had equivalent math scores at pretest. Further, the authors referred to pre- and post-tests but neither the specific amount of gain nor statistics were reported.

Adult basic education. Based on a program evaluation, Mikulecky and Lloyd (1997) reported outcomes of contextualized instruction for 180 incumbent workers in six

companies who participated in work-related literacy classes. The instruction was provided in five of the companies for 20 to 60 hours, and for 200 hours in another, which is equivalent, as the authors pointed out, to six or seven weeks of high school. Participants' initial reading levels ranged from high elementary school grades to college level. The industries in which the instruction was contextualized were the automobile and other manufacturing, prison, insurance, and hospital industries. For example, hospital workers and correctional officers were taught the writing skills needed to improve the quality of written reports and memoranda, and gasket-makers were taught reading skills using company newsletter articles, procedure manuals, and productivity graphs. Some of the participants were taught skills to prepare for promotion tests.

Literacy gains were measured using self-reports gathered in pre- and post-interviews focusing on the workers' literacy practices, beliefs, and plans, as well as strategies they used to read a workplace newsletter and performance on a work-related reading scenario. The researchers created scores from the interview responses, compared the pre- and post-scores using t-tests, and finally, expressed the amount of gain on a three-point scale (positive, neutral, and negative gain). Statistically significant gains were found for the reading scenario, reading strategies, and for literacy beliefs and plans, and the gains were higher than those for a waiting list comparison group in one of the participating companies. In particular, increases in skill were found for students in classrooms in which more than 70 percent of instructional time was spent on reading and writing activities, and students discussed and received feedback on reading and writing processes. However, this evidence is tentative since it is based on self-reports, which can be subjective.

Secondary education. De La Paz (2005) created a learning community of sorts by pairing instruction in social studies and English language arts for eighth graders. In the social studies class, students learned the "historical reasoning" strategy to build an understanding of a topic in the eighth grade social studies curriculum, the history of westward expansion in the United States. This strategy involved reading and reconciling four sets of primary and secondary documents on each issue. In the language arts class, the students received instruction in self-regulated strategy development (SRSD) (Graham, Harris, & Mason, 2005), which involves setting goals for reading and writing and

monitoring progress toward those goals. In the iteration of SRSD used by De La Paz (2005), students were taught how to write persuasive (argumentative) essays through a process of modeling and guided practice. The language arts teacher taught this strategy based on materials used in the social studies class, consisting of set textbook passages, primary documents, and secondary sources besides the textbook. Following this strategy, which was taught over 10 days, steps in writing a persuasive essay were taught using two SRSD mnemonics: STOP (Suspend judgment; Take a side, Organize ideas; Plan as you write), and DARE (Develop a topic sentence; Add supporting ideas; Reject an argument for the other side; End with a conclusion). At the beginning of the intervention, the students wrote personal diary entries about trying to convince someone of something and then discussed the outcomes of these situations in small group. Contextualized instruction in persuasive writing then began, in which the students learned the mnemonics, reviewed sample argumentative essays on the social studies topics, and discussed the five-paragraph structure they would be expected to use. The teacher modeled different planning processes and led students though guided practice using a graphic organizer that depicted the process of writing a persuasive essay. Students were required to reach the criterion of planning and composing an essay of at least five paragraphs within one class period after reading a set of social studies documents.

A comparison group received no instruction in the historical reasoning or argumentative writing strategy, although they read the same social studies texts. Instead of the intervention, the comparison group created a journal about native Americans and other actors in the historical events being studied, involving the recording of factual information. The intervention group showed greater gain than the comparison group on measures of essay length, persuasive quality, the number of arguments included in the essay, and historical accuracy. Interviews with students at the end of the intervention indicated that both groups showed gaps in understanding some of the material but that both groups answered more questions correctly after instruction. The comparison of the two groups' post-test scores showed moderate to strong effect sizes ($d = 0.57$ to $d = 1.23$), suggesting that the contextualized writing instruction was an effective approach. Further, the effects were seen for learners over a range of ability levels, from students with learning disabilities to average- and high-achieving learners. However, a post-only

design was used, and although data gathered before the instruction began did not show statistically significant differences since the comparison group was made up of English language learners, there may have been unmeasured differences between groups.

Brenner et al. (1997) conducted a contextualized intervention that focused on math rather than on reading or writing skills. Contextualized instruction in this case occurred through the use of an everyday life scenario rather than through content-area material. Over a period of 20 days, seventh and eighth graders in a pre-algebra class in an urban school were taught problem solution skills, including the manipulation of symbols in equations. Specifically, students learned to produce and represent functions such as $y = mx + b$.

The problems were cast in a hypothetical scenario where a decision had to be made concerning which of three pizza companies should be selected as a vendor for the school cafeteria. Lessons included taste tests with data collection on student preferences, a computer malfunction scenario where students searched for errors in the pizza maker's order forms and invoices, a pizza delivery game where students had to determine the correct destination, formulas related to advertising the pizza, and tables about profit and loss in the pizza business. Students frequently worked in cooperative groups to discuss and solve the problems. Three teachers taught two sections each, one contextualized and one traditional; the classes were randomly assigned among teachers to treatment and control conditions. The classrooms for each teacher were randomly assigned to conditions. Several curriculum-based and transfer measures were administered to test students' ability to represent and solve word problems. Participants in the intervention showed greater gains than those in the control group in the representation of problems, such as depicting word problems in the form of tables and graphs. Both fluent speakers and English language learners showed this benefit.

Several variables could explain the positive outcome. The intervention and control conditions differed not only in the use of contextualized materials but in whether or not cooperative learning was used. Further, because the materials were contextualized, the treatment focused more on problem representation than on the symbol manipulation that, according to the researchers, is characteristic of traditional math instruction at this level. (In fact, the performance of the control group was significantly higher than that of

the intervention group on symbol manipulation.) Future research would be needed to determine whether contextualization, cooperative learning, the problem representation approach, or a combination of these strategies is most instrumental in explaining the effects of the contextualized intervention.

5.2 Evidence on Integrated Instruction

As mentioned earlier, there are fewer studies of integrated instruction than there are of contextualized instruction, and no studies of integrated instruction were identified within college developmental or academic programs. In this section, examples of integrated instruction in college and secondary career technical education (CTE), and K-12 academic programs are summarized.

CTE: **college.** Jenkins et al. (2009) studied student outcomes in the Integrated Basic Education and Skills Training (I-BEST) program, a special initiative that combines CTE and adult basic education in community colleges throughout the state of Washington. Students in this program are enrolled in non-credit adult basic education and simultaneously take a college-credit occupational course that integrates instruction in occupationally-related reading, writing, and math. Instruction lasts one college quarter, in accordance with the statewide community college calendar. Although the content and number of hours of instruction varies across sites, there is a stipulation that both an occupational and a basic skills instructor must be present in the classroom for at least half of the total instructional time (it is not reported how this time is distributed across class sessions).

Two-year outcomes were compared between a cohort of 900 I-BEST students and two other samples of adult basic education students: one group who did and another group who did not enroll in a traditional, college level CTE course at the same time as the I-BEST students. The comparisons controlled for age, gender, intent (vocational or academic), enrollment full or part time, when first enrolled, and educational history. Net of controls, I-BEST students were more likely than the traditional group to take subsequent credit-bearing courses, earn credits toward a certificate or degree, persist to the next college year, and to show gain in basic skills. I-BEST students' basic skills improvement was 18 percentage points higher than adult basic education students who

did not enroll in a traditional occupational course and 9 percentage points higher than adult basic education students who took an occupational course. Thus, the major advantage of I-BEST was seen when the comparison group took only adult basic education but not an occupational course. These results provide encouraging evidence for integrated instruction, but conclusions remain tentative as the sample was self-selected, presenting the possibility of a confound with student motivation. As the authors noted, I-BEST correlated with, but did not necessarily cause, the positive outcomes.

   CTE: secondary education. Stone et al. (2006) investigated the effects of integrating math instruction into five CTE areas—agriculture, auto technology, business/marketing, health, and information technology—using a "Math-in-CTE" model. The purpose of the instruction was to broaden students' knowledge of math concepts they learned in CTE and have students "recognize how to solve practical problems by using mathematics in their occupational area; recognize math occurring in other contexts; and do so without diminishing the acquisition of technical knowledge in the course" (p. 5). However, it was not explained why technical knowledge might diminish by a broadened approach to math instruction. Math instruction assumed prior knowledge of algebra. Initially, highly contextualized math problems were taught, along with the inclusion of more abstract examples. For instance, when students used a T-square during instruction in agricultural mechanics, the teacher presented the Pythagorean theorem by showing the formula $a^2 + b^2 = c^2$. However, ultimately, the goal was that "students would see the math as an essential component of the CTE content, a tool—like a saw, wrench, or thermometer—needed to successfully solve workplace problems" (Stone et al., 2006, p. 6).

   Teachers of 57 classrooms in 12 states were recruited on a volunteer basis and randomly assigned to conditions (57 experimental and 74 control). The CTE teachers in the experimental condition collaborated with math teachers to identify math problems embedded in the existing CTE curricula and to create lessons highlighting mathematical operations. The math-enhanced CTE lessons constituted 10 percent of instructional time over one academic year. The math lessons contained seven elements: introduce the CTE lesson; assess math skills relating to the CTE lesson; work through a math problem embedded in the CTE lesson; work through related, contextualized examples; work

through traditional math examples; have students demonstrate their understanding; include math questions in formal assessment at the end of the CTE unit or course (Stone et al., 2006, Figure 1, p. 12).

Pre- and post-tests on two standardized math tests, the TerraNova and Accuplacer, showed significantly greater gain for the experimental group (effect sizes 0.42 and 0.55). When occupational tests used in each participating classroom were administered at post test, no significant differences were found between the experimental and control groups. The authors interpreted this to mean that the math instruction was not detrimental to a growth of knowledge in the CTE field, but since the math enhancement was presumably in the interest of an increase in occupational knowledge, the findings can also be interpreted to mean that the math enhancement did not advance CTE performance. Again, as mentioned above, it was not clear why there might be any chance of the math instruction lowering students' occupational knowledge; given the theory that math should enhance occupational performance, one would expect the opposite. It seems more logical to conclude that the intervention was not effective in improving job-related knowledge.

Following on the work of Stone et al. (2006), Parr et al. (2008) randomly assigned 38 teachers of an agricultural power and technology course in high schools across the state of Oklahoma to teach a math-enhanced or traditional CTE curriculum. Teachers in the experimental group worked with math teachers to insert course-related math instruction into nine of the CTE lessons. There was no statistically significant difference between the students in the experimental (206 students) and control conditions (241 students) in math aptitude prior to the intervention. After the intervention period, students were given a standardized test on course content (NOCTI Agriculture Mechanics examination). At the end of the intervention, both groups had similar scores. As in the Stone et al. (2006) study, this result was interpreted to mean that enhancing the curriculum with math did not reduce students' knowledge of the agricultural content. However, it can also be interpreted to mean that the math enhancement did not promote students' content knowledge.

Academic programs: K-12. Building on De La Paz's (2005) eighth grade study of contextualized instruction described earlier, De La Paz and Felton (2010) investigated

the effects of an intervention that taught both historical reasoning and persuasive writing in an 11th grade 20th century history course. Whereas in the earlier study the writing skills were taught by language arts teachers, in the De La Paz and Felton study, history teachers provided this instruction.

Participants were $n = 79$ students in experimental classrooms and $n = 81$ students in comparison classrooms in two schools. In the experimental (integrated instruction) condition, which lasted several weeks, the history teachers introduced and modeled steps in the writing of persuasive essays on historical topics and then proceeded to teach the content using the historical reasoning strategy used in the earlier study. Toward the end of a two-week instructional period, the students were given guided practice in the writing of two persuasive essays on the topics taught. The STOP and DARE mnemonics from De La Paz's 2005 study, described above, were used to help students plan their essays. The writing instruction and guided practice focused on specific elements of persuasive writing: writing a topic sentence that stated a position on a historical controversy, providing reasons for their position, using evidence to support claims, presenting a counterargument with evidence, and refuting the opposing point of view, presenting new evidence. Participants had low to average writing skills, and none received special education or English language services. A persuasive writing task was administered pre- and post-test to measure the effects of instruction. Students in the comparison classrooms received traditional instruction, without the historical reasoning or writing strategy instruction. They were assigned to write the same two essays as in the experimental condition during the course of instruction, without the support of writing instruction.

Pre- and post-test persuasive essays were analyzed for length, persuasive quality, and historical accuracy. At post-test, the essays written by the experimental group were longer (effect size $d = 0.66$), approximately one third more likely to include elaborated claims, three times more likely to include elaborated rebuttals than the comparison group when controlling for essay length, and cited historical documents in support of claims more often (effect size 1.42 SD units). The finding that rebuttals of historical claims became more elaborated among the group receiving integrated instruction is notable, as this aspect of persuasive writing is particularly challenging (Ferretti, Lewis, & Andrews-Weckerly, 2009). These results support the practice of integrated instruction, although it

is not possible to determine from this study whether the positive outcome is attributable to the writing or history strategy, or both in combination.

A well-controlled study of integrated instruction was conducted by Vaughn et al. (2009) with low-income seventh grade social studies students, approximately one third of whom spoke Spanish as a native language and who were not proficient speakers of English.[17] Assignment to condition was unusually rigorous; first, students were randomly assigned to classrooms, and then classrooms were randomly assigned to an intervention or to a business-as-usual control condition. The social studies material was identical in both conditions. The intervention involved explicit reading comprehension and vocabulary instruction; the control condition did not receive any literacy instruction but only focused on the social studies content. The integrated instruction was delivered for 50 minutes per day, five days per week for nine to 12 weeks. Four new vocabulary words were taught per day. All vocabulary was drawn directly from the social studies text.

To teach vocabulary, after giving an overview of a "big idea" relating to the historical topic, the teacher pronounced each vocabulary word, identified a Spanish cognate or translated the word into Spanish, provided a definition in everyday language, showed a visual representation of the word, and put each word into two sentences, one in historical context from the class reading and the other relating to students' everyday life experience. The students then discussed each word in pairs. A 2- to 4-minute video clip on the topic was then shown and discussed. Then a graphic organizer was used to support silent and oral reading comprehension, and students worked in pairs to read the text and answer questions. In the paired reading, one student read while the other followed along, with the first student interrupting to correct the reader as needed. The teacher then led a whole-class discussion of the answers to the questions, and, as a writing activity, worked with students to summarize information on the topic using the graphic organizer.

On researcher-developed measures of vocabulary matching and reading comprehension, the experimental group showed greater gain than the control group, with effect sizes of $g = 1.12$ for reading comprehension and $g = 0.53$ for vocabulary. Importantly, the integrated instruction was equally effective with proficient speakers of

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[17] Twenty-five percent of the Spanish speakers were designated as English language learners (ELLs) and the others had completed ELL instruction but were still considered Limited English Proficient (LEP).

English and ELL/LEP students. The study only evaluated literacy outcomes; the effect of the integrated instruction on content knowledge was not measured. However, what is impressive about this study and the one conducted by De La Paz and Felton (2010) is that content-area instructors, who generally shy away from teaching literacy skills (Fisher & Ivy, 2005), not only taught reading and writing skills as part of their disciplinary instruction, but also obtained positive results.

Bulgren et al. (2009) conducted a short-term "content-enhancement routine" intervention (two 89-minute sessions taught five days apart) with 36 typically developing and learning disabled (LD) students in grades 9–12 in an inner-city school. While the teachers in Vaughn et al.'s (2009) study were social studies teachers, in Bulgren et al.'s (2009) intervention, the instructors were researchers rather than classroom teachers. In this study, students were randomly assigned to intervention and control groups, using stratification to ensure equal representation of LD and non-LD students. The intervention group learned a strategy for taking notes and learning vocabulary based on a 30-minute film on ozone depletion (Vaughn et al., 2009 also used a film during instruction) in order to prepare to write an essay on climate change.

The note-taking process was taught using a "question exploration guide," which is an organizational structure for recording important information in the film. Sections of the guide listed several questions that student had to answer, including: "what is the critical question?", "what are they key terms and explanations?", "what are the supporting questions and answers?", and "what is the main idea?". Other questions related to experiments that could be conducted and to applications of knowledge about the ozone depletion issue to students' individual lives. The control group viewed the film twice and was asked to take notes, with no instruction.

Outcomes were measured using an essay on ozone depletion. Using two separate measures, the essays were scored for the quality of the writing, and, unlike the study by Vaughn et al. (2009) above, content knowledge was also assessed. Writing quality referred to the ideas expressed in the essay, organization, voice, word choice, sentence construction, and the use of written English conventions. The content score measured identification of the problem, cause, effect, solution, and a conclusion on the issue. At post-test, the writing quality scores of the experimental group were 25 percent better than

those of the control group ($d = 1.32$). Superior gains for the treatment group were seen for every writing quality variable except writing conventions. The intervention group also showed greater gain than the control group on content knowledge ($d = 0.74$). However, when the scores for the learning disabled and typically developing students were disaggregated, only the typically developing students showed greater gain than the control group ($d = 2.0$). The results of this integrated instruction approach are encouraging, but conclusions are limited by the fact that the activity in the control condition seems considerably less compelling. Other methodological limitations are that instruction was delivered by researchers rather than by classroom teachers and that the intervention was very short, only lasting two sessions.

Similar to Bulgren et al. (2009), Tilson et al. (2010) taught an experimental science unit that integrated literacy instruction. While Bulgren et al.'s (2009) study was a small-scale experiment in secondary education, Tilson et al.'s (2010) participants were fourth graders in 94 classrooms in 48 elementary schools. Students were randomly assigned to experimental ($n = 217$) or control ($n = 241$) classrooms. The science unit focused on physical science (light and energy) and was taught in forty 60-minute sessions. Forty-percent of instructional time was spent on science, 40 percent on literacy (reading, writing, speaking, and listening),[18] and the remaining 20% of the time on formative assessment.

Several types of science-related writing were embedded in the science instruction, including the recording of data, written responses to informational text, and reports on what students learned in group discussions. Instruction was provided on constructing topic sentences, providing supporting evidence, and using scientific vocabulary in a precise way. The teacher modeled the entire writing process at the beginning of a unit. Also, the students were taught to use graphic organizers and worked in pairs to plan writing tasks. As an example of the integrated instruction, one of the lessons involved testing various materials to investigate the phenomenon of reflection. Students created a data table and read a text on the topic, after which they wrote explanations to show their understanding of the nature of reflection.

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[18] Literacy is often defined in terms of these four functions (National Governors' Association & Council of Chief State School Officers, 2010).

In the control condition, students used the same text, experiential activities, and were assigned reading and writing tasks but did not receive any explicit literacy instruction. All students were tested pre and post on writing skills using an experimenter-designed instrument. The quality of students' writing was scored on the accuracy of the science content, the use of evidence, the quality of the introduction and conclusion, clarity of expression, vocabulary usage, and vocabulary count, defined as how many of 32 science terms targeted during instruction were included in the writing sample. The treatment group showed statistically significantly greater gain from pre to post than the control group on all of the writing measures except vocabulary usage and quality of conclusion (effect size on a composite score of all of the writing dimensions $d = 0.69$).

6. Trends in the Research

The studies identified in this review provide preliminary support for the hypothesis that low-skilled students can learn more effectively and advance to college-level programs more readily through the contextualization of basic skills instruction. Conclusions are very tentative at present because of the shortage of rigorous studies with academically-underprepared students in college or adult basic education programs. Research with K-12 samples was included in the review since there was relatively little information on the use of contextualization in adult basic education or college settings, but there does not seem to be any reason why findings from elementary and secondary education cannot be extrapolated to older adolescent and adult learners.

As shown in Table 1 (Appendix), 27 studies reporting quantitative evidence on the contextualization of basic skills were found. Outcome measures for almost all of the studies focused exclusively on, and found gains for, specific basic skills outcomes, i.e. reading, writing, or math scores. All of the outcomes of contextualization for basic skills achievement were positive, although there was minor variation in outcomes for subskills and different measures. For example, in a college CTE study integrating writing instruction in a business course, students improved their ability to write a business abstract but not to express business concepts in their own words. In another study of integrated instruction, Tilson et al. (2010) found that students receiving writing

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instruction performed better than a control group on the use of science content and evidence, the quality of the introduction, clarity and vocabulary count in an essay, but the control group performed better on the quality of the conclusion to the essay as well as vocabulary use. Workplace literacy and developmental education students receiving contextualized instruction in studies by Ekkens and Winke (2009), Perin (1997), and Perin et al. (2010) showed gain on researcher-developed but not standardized measures. However, despite these differences, there is a very strong trend in the research toward positive findings for both contextualized and integrated instruction.

It should also be noted that most of the studies compared contextualization to a business-as-usual comparison group, indicating that contextualization is more effective than standard, non-contextualized practice. This is a good start in examining the potential of contextualization, but more definitive conclusions can only be made when contextualization is compared to another intervention in addition to conventional instruction so that results can be attributed to contextualization itself and not to other dimensions of the research such as novelty or the added attention that may be given to participants in a "treatment."

One of the assumptions underlying integrated instruction is that when basic skills instruction is incorporated in disciplinary instruction, ability in both academic skills and content knowledge should increase. However, in five studies of integrated instruction that measured outcomes on knowledge development in a content area (Bulgren et al., 2009; De La Paz & Felton, 2010; Parr et al., 2008; Stone et al., 2006; Tilson et al., 2010), two found no improvement in content knowledge (Parr et al., 2008; Stone et al., 2006). Both of these studies embedded math in occupational courses in high school CTE. Since strong claims are made for the advantages of combining literacy with subject area instruction, these mixed findings are disappointing and warrant further research.

Only two studies, Wisely (2009) and Jenkins et al. (2009), provided data on the second part of the hypothesis under consideration in this review, i.e. on college advancement. Wisely (2009) found that participation in contextualization was associated with the completion of developmental education courses, and the speed of entry into, and performance and completion of, college level courses. However, these positive effects were limited to non-white students; no effects for contextualization were found for white

students. Jenkins et al. (2009) found that adult education students who attended occupational classes that integrated basic skills instruction were more likely than adult education students who either did or did not enroll in a traditional occupational course to take subsequent credit-bearing courses, earn credits toward a college credential, persist to the next college year, as well as show greater gain in basic skills. Given practitioners' enthusiasm about the value of contextualization (see program descriptions in E. Baker et al., 2009; Boroch et al., 2007; California Community Colleges, 2008), it is unfortunate that more evidence is not available.

7. Practical Implications

The presence of large numbers of low-skilled students in colleges, especially community colleges, along with low rates of retention and progress in course work (Bailey, Jeong, & Cho, 2010a, 2010b) and recent findings that traditionally low graduation rates are not increasing (Radford, Berkner, Wheeless, & Shepherd, 2010), suggests that the method of instruction of academically underprepared college students needs to be reformed. Among the many different innovations underway that attempt to promote the learning of low-skilled college students (Perin & Charron, 2006), contextualization seems to have the strongest theoretical base and perhaps the strongest empirical support. Both forms of contextualization, i.e. contextualized and integrated instruction, are supported by quantitative studies that include control or comparison groups. There are more studies on contextualized instruction than there is on integrated instruction, but both forms of contextualization appear potentially valuable.

Moving toward contextualization in general and toward contextualized or integrated instruction in particular will depend on practical conditions internal to the colleges. Most important among these conditions are instructors' willingness to modify their instruction and colleges' ability to provide incentives and support for this change. Many developmental education instructors are not highly aware of the day-to-day reading and writing requirements that students find so difficult in college credit disciplinary courses. Further, they are strongly committed to the generic, decontextualized instruction in reading, writing, and math that predominates in developmental education (Grubb,

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1999). On the other hand, disciplinary instructors may be equally unwilling to consider contextualization because they feel that basic skills instruction is beyond their range of responsibility and/or competence (Marri et al., in press; McDermott, 2010). Strong college leaders will need to provide ongoing direction and support for either version of contextualization.

The following recommendations may support the implementation of contextualization for low-achieving students in a college setting:

1. Create conditions for interdisciplinary collaboration so that basic skills and content area instructors can familiarize each other with their curricula, assessment approaches, standards, and teaching techniques (E. Baker et al., 2009; Greenleaf et al., 2010; Kalchik & Oertle, 2010; Perin, 2005; Shore et al., 2004; Stone et al., 2006). It is important that instructors visit each others' classrooms, discuss their educational philosophy and instructional techniques, jointly analyze the literacy and math demands of content instruction, look for intersects between their instructional topics, and collaborate to align curricula so that students can be taught reading, writing, or math skills that are directly applicable to the subject areas they are learning. Substantial time is required for this effort.

2. Provide ongoing professional development, led by trainers who have experience in contextualization, to initiate and support contextualization. Professional development leaders should be experts from within the institution rather than outsiders (Kozeracki, 2005). Formal professional development should be conducted with interdisciplinary groups of instructors and should be designed to meet tangible targets for implementing contextualized or integrated courses. Evidence-based professional development methods should be utilized, such as interdisciplinary inquiry-based approaches that involve coaching and intensive institutes (Greenleaf et al., 2010). Further, professional development should be guided by common cross-discipline agreement on desired learning outcomes for contextualization and means of achieving them (E. Baker et al., 2009). Follow-up activities and supportive monitoring should be provided after the conclusion of formal training sessions to maintain instructors' interest in and ability

to contextualize or integrate basic skills instruction. Greenleaf et al. (2010) noted that "A long history of research in reading has demonstrated that reading comprehension strategies are not often taught in subject-area classes, even when teachers are trained to use these strategies during subject-area teaching." (p. 15). To avoid this situation, follow-up coaching and support of respected instructional leaders will be needed.

3. Develop assessment procedures that incorporate both basic skills and content area knowledge to evaluate the effects of contextualization. For example, in Shore et al.'s (2004) study, developmental math and allied health instructors collaborated to create allied health math problems. Both De La Paz and Felton (2010) and Perin et al. (2010) included measures of content accuracy in instruments to measure contextualized writing, and Guthrie et al. (1999) developed fine-grained assessment methods that simultaneously measured reading comprehension strategies and science knowledge. It appears that such measures will need to be locally developed, because disciplinary curricula tend to change, and conventional standardized tests do not capture students' progress in contextualized basic skills (Greenleaf et al., 2010), although customized subject-specific basic skills tests can be developed and normed (Lazar et al., 1998).

4. As the basis of contextualization of basic skills instruction in community colleges, select discipline-area courses that are needed for graduation by large numbers of students but that also have high failure rates. Because contextualization is a labor-intensive initiative, it will be necessary to select courses for implementation. Initial attempts should focus on courses that have the highest need, represented by failure rates. Anecdotal evidence suggests that introductory science courses such as anatomy and physiology that are required for graduation by popular majors such as allied health may be a useful place to start, since these courses display high failure rates, and descriptive and quantitative studies are available on the contextualization of basic skills instruction in science content (Bulgren et al., 2009; Guthrie et al., 1999; McDermott, 2010; Perin et al., 2010; Shore et al., 2004).

5. When contextualized courses are established, collect outcome data for examination by instructors and administrators alike. For example, the use of evidence to guide instructional practice in community colleges is a central reform strategy of Lumina Foundation's Achieving the Dream initiative (Achieving the Dream, 2005). Instructors who implement contextualization and administrators who support this effort should be made aware of both short- and longer-term outcomes, such as the rate of passing basic skills and disciplinary courses, grade point average, semester-to-semester retention, and degree or certificate attainment. Evaluating contextualization in this way will indicate whether the effort is worthwhile, and may point to the need to modify teaching techniques.

8. Future Research Directions

The lack of rigorous research suggests that it is premature to invest substantial funds in a contextualization intervention at this time. However, practitioners have been enthusiastic about contextualization for many years, trends in the available research have been positive, and it is consistent with contemporary theories of learning and motivation. For these reasons, it would be worthwhile to mount a rigorous research and development effort to gather information about the potential efficacy of this approach, specifically with low-skilled adult learners, whether in community college degree and certificate programs, or in adult basic education programs.

A major premise underlying the practice of contextualization of basic skills is that students are more likely to transfer the skills to subject-area learning when the instruction is connected to these subject areas rather than taught abstractly. A topic that has not been addressed in studying the effects of contextualization on transfer of learning is possible interactions between student ability, student motivation, type of skill to be learned, and amount of contextualization. Thus, in either research and development, or basic research investigations, moderators of the possible effects of contextualization should be identified. Experiments investigating contextualization as an instructional intervention should include comparisons with performance on alternate interventions as well as with

business-as-usual comparison groups to ensure that effects of contextualization are not attributable simply to novelty or to increased attention.

Anecdotal evidence from practitioners (E. Baker et al., 2009; Boroch et al., 2007; Johnson, 2002) suggests that lower-skilled students benefit from contextualization, not because it helps them become flexible learners but because it increases their mastery of basic skills as well as increases the likelihood of transfer of basic skills to content courses that is not occurring in traditional, decontextualized learning environments. There is very little research on the relation between the contextualization of basic skills instruction and subsequent course work, and among the little information that exists, it is not possible to attribute the gains exclusively to contextualization. Future research paradigms should control for variables such as the nature of the course, teacher expertise, and cognitive and affective characteristics of learners.

The issue of dosage of contextualization should also be studied, in light of claims that instruction can be overcontextualized and as such can be counterproductive (e.g., see Bransford et al., 2000). Another area that needs attention is the nature of the dependent variable used in studies of contextualization. The studies in this review varied on whether they measured both basic skills and subject-area gains, or just the former. Dependent variables in future research on contextualization of basic skills should include both basic skills and subject matter learning, since the intent of the intervention is to bring the two areas closer together and increase learning in both.

9. Conclusion

The contextualization of basic skills in disciplinary content is used in elementary, secondary, and postsecondary education as a way to engage students, deepen content learning, and promote transfer of skill. The approach is well grounded in psychological theories of transfer (although there is debate in this area on dosage) and motivation. There is support in the literature for the two forms of contextualization identified in this review, contextualized instruction, which is taught by developmental education instructors and English and English language arts teachers, and integrated instruction, which is provided by discipline area instructors.

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A greater amount of literature is descriptive than evaluative, but the 27 studies found in this review that reported evidence suggest that contextualization has the potential to promote short-term academic achievement and longer-term college advancement of low-skilled students. However, the studies also indicate that considerable effort is needed to implement contextualization because instructors need to learn from each other and collaborate across disciplines, a practice that is not common in college settings. Further, there is very little information on cost or what would be needed to scale up contextualization. However, the available evidence, taken in combination with practitioners' considerable enthusiasm for contextualization, suggests that this approach would be a useful step toward improving the outcomes of academically underprepared college students.

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Appendix

Table 1
Evidence for Contextualization

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
COLLEGE						
Caverly et al. (2004) (Experiment 2) - **C**	Quasi-experimental, treatment vs. no-treatment comparison (paired t-tests and Mann-Whitney U)	Developmental education: **reading**	Reading strategy taught using chapters from textbook assigned in concurrent college-level history course. Strategy focuses on predicting information, applying prior knowledge, confirming prior knowledge through close reading, and representing the information in the text on a chart.	Standardized reading test (TASP-Reading), grade in reading-intensive course (history)	Comparison < treatment on pre-post gain on reading test, and post-only history grade.	Comparison group did not take developmental education—confounding of course and strategy taught; 4-year gap between pre and post tests; no covariates
Martino et al. (2001) - **C**	Quasi-experimental, comparison of two contextualized reading instruction treatments (ANOVA)	Biology students with low **reading** levels	Treatment 1, fully contextualized: Communicative Reading Strategies (CRS), used only biology textbook, instruction on graphophonic, phonemic, lexical, syntactic, conceptual and discourse structure skills; prior knowledge, oral reading, factual questions, making inferences, generalizing information to new situations. Treatment 2, partly contextualized: Skills Instruction, used traditional reading text and reading skills worksheets related to biology text.	Standardized test (Nelson Denny Reading Test) and researcher-designed weekly biology comprehension probes	Both groups gained on standardized reading test, no group x time interaction. Same amount but faster increase in biology comprehension for Treatment 1.	Number too small (8 total) to make statistical inferences

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Perin et al. (2010) - **C**	Quasi-experimental, treatment vs. no-treatment comparison; randomization to treatments within classrooms (ANCOVA/ regression)	Developmental education: **reading and writing**	Weekly independent practice in written summarization, question-formulation, and vocabulary development; use of reading comprehension quizzes and persuasive writing using biology text	Researcher-designed summarization & standardized reading test: Nelson-Denny comprehension	Controlling for student background, comparison < treatment on pre-post gain on 3 summarization variables (effect sizes 0.33–0.62 SD units) but not standardized reading test; performance better with science than generic text on 2 summarization variables.	Intervention did not provide feedback to students; unknown level of contamination between conditions in same classrooms
Snyder (2002) - **C**	Quasi-experimental, treatment vs. no-treatment comparison (within and between-subjects t-tests)	Developmental education: **reading**	Reading comprehension strategies (question-generation, clarification, prediction, and locating main ideas) taught using text assigned in freshman seminar on writing, philosophy, and speech	Standardized reading test: Nelson-Denny comprehension	Comparison < treatment on amount of pre-post gain but still significantly lower than comparison group on post-test	Comparison group began with higher reading levels (tested out of developmental education)
Shore et al. (2004) - **C**	Quasi-experimental, treatment vs. no-treatment comparison group (no inferential statistics)	Developmental education, allied health: **math**	Math taught using problems drawn from allied health curricula. Developmental and content instructors collaborated to create problems.	Researcher-designed math test	In first 2 years but not in 3rd year of program, higher math scores for contextualization than comparison group	Test scores and inferential statistics not reported, little information on methodology provided

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Wisely (2009) - **C** and **I**	3 groups compared: contextualized, traditional course but contextualized offered at college, traditional course, contextualized not offered at college, demographic controls (logistic regression)	College CTE: **math**	33 credit math courses contextualized or integrated math skills in material from CTE courses taken by students.	Dichotomous: pass basic skills course, persist to enrollment in credit course work next term	Contextualization predicted non-white students' completion of math course, and speed of entry into, performance in, and completion of other college level courses	Teachers self-reported on contextualization, not independently verified; CTE students not tested for math skills, may have been low skilled (developmental level)
Cox et al. (2004) - **I**	One group, pre-post (within-subjects t-test)	CTE, business: **writing**	Instruction in writing business abstracts and research reports on specific industries; writing tasks assigned to support learning of business content; instruction provided within business course	Pre-post researcher-designed test of ability to write abstract of business article	Increase in ability to write business abstract but not using own words (statistically significant decrease); increase in quality of business reports	No control group, no moderators included in statistical analysis
ADULT BASIC EDUCATION						
Dirkx & Crawford (1993) - **C**	Quasi-experimental: treatment vs. no-treatment comparison (no inferential statistics)	Adult basic education, maximum security prison inmates: **reading and writing**	Reading and writing instruction contextualized in earth, life, and physical sciences on assumption that learning about natural world would motivate students.	Pre-post reading test, self-reported reading habits attendance, observations of learner engagement	5 of 9 treatment students compared to 2 of 9 comparison students scored higher on post than pre reading test. Attendance and student engagement: comparison < treatment	Small sample size (9 in each group); little information on reading test; reading habits self-reported

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Ekkens & Winke (2009) - **C**	One group, pre-post (within-subjects correlations and t-tests)	Adult basic education, workplace literacy, English language learners: **reading**	Grammar and vocabulary contextualized in time management, culture of work, and communication topics using health and manufacturing materials	Standardized test: Comprehensive Adult Student Assessment System (CASAS), reading and listening subtests; self-ratings of satisfaction and learning	Little or no gain on standardized tests of listening and reading but high self-ratings of satisfaction and learning	No control group; use of self-ratings.
Lazar et al. (1998) - **C**	One group, pre-post (within-subjects t-tests)	Adult basic education, workplace literacy, health care workers, and administrative assistants: **reading, writing, and math**	Literacy instruction contextualized in simulations of on-the-job teamwork using materials used in health care and administrative assistance jobs, for job upgrading.	Standardized tests: Adult Learning Employment-Related Tasks (ALERT) and Tests of Adult Basic Education (TABE) reading and math subtests; researcher designed writing quality, writing fluency, and vocabulary measures; employee and supervisor ratings of job literacy; employer ratings of job performance	Statistically significant increase on all basic skills and job literacy measures except writing fluency.	No control group.
Mikulecky & Lloyd (1997) - **C**	One group, pre-post (within-subjects t-tests)	Adult basic education, workplace literacy: **reading**	Reading instruction in several worksites contextualized in materials from manufacturing, prison, insurance, and hospital settings.	Researcher designed measures of reading practices, self-efficacy, and job-related reading created from interview responses	Statistically significant pre-post gain on all measures except amount of reading on and off the job	Scores based on self-reports. Waiting list control group for one worksite but pre-post data not reported for this group.

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Perin (1997) - **C**	One group, pre-post (within-subjects t-tests)	Adult basic education, workplace literacy, psychiatric health care aides: **reading and writing**	Reading and writing contextualized in health care jobs	Test of Applied Literacy Skills (TALS), prose subtest; Tennessee Self-Concept Scale; researcher designed job-related reading (2 versions, harder and easier), writing, and self-efficacy tests	Gains shown on all measures except TALS and harder version of researcher-designed reading test	No control group.
Sticht (1995) - **C**	Quasi-experimental, treatment vs. traditional instruction comparison (no inferential statistics)	Adult basic education, army recruits: **reading**	Reading instruction ("FLIT" program) contextualized in job materials such as manuals.	Researcher-designed general and job-related reading tests	More gain on job-related than general reading in treatment group. Comparison < treatment in gain on job-related reading	Little information on nature of measures; inferential statistics not reported.
Jenkins et al. (2009) - **I**	Treatment and comparison groups compared (linear and logistic regressions). Treatment = enrollment not completion	Adult basic education: I-BEST program: **reading, writing and math**	Non-credit basic skills course paired with credit occupational education course. Reading, writing, and math instruction used job content; team teaching by academic skills and occupational instructors. (Comparison took adult basic education and, for some, a traditional occupational course.)	College credits, persistence to following year, earn degree or certificate, gain on standardized reading, writing, math skills tests	Comparison < treatment on college persistence, and literacy and math gain	Possible selection bias

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
SECONDARY EDUCATION						
De La Paz (2005) - **C**	Quasi-experimental: post-only treatment vs. comparison(one-way ANOVA – condition by writing quality)	Typically developing, high achieving and learning disabled 8th graders: **writing**	Language arts teacher taught strategy for persuasive writing contextualized in history of U.S. westward expansion; course paired with history course.	Researcher designed measures of essay length, persuasive quality, number of arguments, historical accuracy of persuasive writing sample	Comparison < treatment on all measures (d = 0.57 to d = 1.23)	Treatment group consisted of typically achieving and learning disabled students; comparison group consisted of English language learners; no pretest
Bottge (1999) - **C**	Quasi-experimental: comparison of two treatments taught to different classes: contextualized problem and word problem, matched treatment groups (repeated measures ANCOVA)	Typically developing and remedial students, 8th grade: **math**	Math instruction contextualized in videotaped scenarios of real-life shopping problems, compared with traditional math instruction	Pre-post fractions computation, word problem, contextualized problem, and two transfer tests	Word problem < contextualized problem condition on contextualized problem and transfer tests; no differences in fractions computation or word problems	Despite matching process, higher pre-existing math and self-efficacy scores in contextualization group

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Bottge & Hasselbring (1993) - **C**	Experimental: random assignment of matched students to contextualized problem and word problem conditions (t-tests and repeated measures ANOVA)	Students with learning disabilities in 7–9th grade: **math**	Same as Bottge (1999): math instruction contextualized in videotaped scenarios of real-life shopping problems, compared with traditional math instruction	Researcher designed fractions computation, contextualized problem and transfer tests	Word problem < contextualized problem group on gain on contextualized and transfer problems	
Brenner et al. (1997) - **C**	Experimental: random assignment of classes to contextualized or traditional condition (ANCOVA)	7–8th grade pre-algebra students: **math**	Pre-algebra problems taught using real life scenario involving selection of pizza company as vendor for school cafeteria	Pre-post researcher designed function word problem, word problem representation, word problem solving, and equation solving (symbol manipulation) tests	Control < treatment in gain on function and representation tests; treatment < control on symbol manipulation	Instructional differences besides contextualization: treatment group received cooperative learning and focused more on problem representation than symbol manipulation
Bulgren et al. (2009) - **I**	Random assignment to treatment or traditional instruction (ANCOVA)	9th–12th grade science students: learning disabled and typically developing: **reading and writing**	Short-term intervention embedding reading and writing instruction in science instruction.	6-Trait Model of Analytic Scoring (ideas, organization, voice, word choice, sentence fluency, and researcher-designed conventions in writing sample) and content score (name problem, cause of problem, effect of problem, solution, and main idea)	Control < treatment on both writing and content scores, effect sizes $d = 1.44$ and $d = 0.74$	Instruction by researchers, not teachers in classrooms, short duration (only 2 sessions)

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Greenleaf et al. (2010) - **I**	Experimental: schools randomized to treatment or control (hierarchical regression)	High school biology, 2 samples (longitudinal—parental consent; cross-sectional—no consent, anonymous, delinked data): **reading**	High school science teachers integrated reading instruction after receiving professional development	Statewide standardized tests: California Standards Test, biology, English language arts (ELA) and reading comprehension subtests	Longitudinal sample: no difference treatment and control; cross-sectional sample (author states more representative): control < treatment, effect sizes 0.23., 0.24, 0.28 SD units for biology, ELA and reading	Attrition: 54% of teachers remained to end of study; because of selective attrition of teachers, treatment classes had higher proportions of low skilled and ELL students than control
De La Paz & Felton (2010) - **I**	Quasi-experimental: integrated compared to traditional history instruction (repeated measures ANCOVA and ordinal regression)	11th grade history students: **writing**	History teachers taught historical reasoning strategy and integrated writing instruction in course on 20th century American history	Measures based on persuasive writing sample: essay length, essay quality, development of arguments, claims, rebuttals, reference to documents	At post-test, comparison < treatment on essay length, quality, rebuttals, and accuracy	Experimental condition involved innovative practice in both history (historical reasoning strategy) and writing, not possible to attribute findings specifically to integration of writing instruction
Vaughn et al. (2009) (Experiment 2) - **I**	Experimental: students randomly assigned to course sections and sections randomly assigned to treatment or control condition (ANCOVA)	7th grade social studies: English language learners (ELLs) and native speakers of English: **reading**	Reading comprehension and vocabulary instruction integrated in social studies	Pre-post vocabulary and comprehension measures	Control < treatment on both comprehension and vocabulary measures ($g = 1.12$ and $g = 0.53$); equally effective for ELLs and native speakers	Comprehension measure may have underestimated performance in requiring written rather than forced choice responses

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Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Parr et al. (2008) - **I**	Experimental: post only, teachers randomly assigned to treatment or control condition (ANOVA)	High school CTE: **math**	Math taught in 9 lessons in agricultural power in a technology course (math-enhanced CTE)	NOCTI Agriculture Mechanics examination	No difference in treatment and control on occupational content (authors argue this is positive finding—math instruction did not diminish occupational learning)	Math was taught but math outcomes not measured.
Stone et al. (2006) - **I**	Experimental: teachers randomly assigned to treatment or control condition (hierarchical regression)	High school CTE: **math**	Math-enhanced CTE instruction in agriculture; auto technology; business and marketing; health; and information technology courses (math-enhanced CTE); 10% of instruction in 1 academic year	Post-test: (1) students randomly assigned to take TerraNova CTBS Basic Battery, ACCUPLACER Elementary Algebra test, or WorkKeys Applied Mathematics Assessment; (2) occupational tests, varied across schools. Pre test: Terra-Nova scores	Control < treatment on gain on TerraNova (d = 0.55) and ACCUPLACER (d = 0.42) math but not occupational tests (authors make same argument as Parr et al. above)	
ELEMENTARY EDUCATION						
Brenner et al. (1997) - **C**	Quasi-experimental: post-only treatment vs. comparison (t-test)	Native Hawaiian kindergartners: **math**	Math taught in context of everyday life money problems, and Native Hawaiian themes; math vocabulary introduced in Hawaiian Creole.	Metropolitan Achievement Test, math and reading subtests	Comparison < treatment on math but not reading	No pretest

Reference & Type of Contextualization	Design & Analysis	Sample & Skill Area	Nature of Instruction	Dependent Variables	Results	Methodological Flaws
Guthrie et al. (1999) - **I**	Quasi-experimental: post-only treatment vs. comparison, pretest reading covariate (MANCOVA)	3rd and 5th graders: **reading**	"Concept Oriented Reading Instruction:" integration of science and reading comprehension instruction	Pre test: California Test of Basic Skills (3rd graders), Metropolitan Achievement Test (5th graders). Posttest: performance assessment of reading and language arts—2 forms, familiar and unfamiliar topics: prior knowledge, strategy use, drawing, writing, conceptual transfer, informational text comprehension, narrative interpretation	Controlling for student background, comparison < treatment on strategy use, conceptual learning, and text comprehension; better transfer to new domain at grade 3 than grade 5.	Probable contamination of treatment and comparison instruction
Tilson et al. (2010) - **I**	Experimental: random assignment of classrooms to treatment or control (ANCOVA)	4th graders: **writing**	Writing instruction embedded in science instruction. Students taught to write explanations of light and energy: constructing topic sentences, including supporting evidence, and using scientific vocabulary	Researcher-designed writing measures: science content, use of evidence, quality of introduction and conclusion, clarity, vocabulary usage, and vocabulary count	Control < treatment on composite writing score d = 0.69. On separate writing skills: control < treatment: science content, use of evidence, quality of introduction, clarity, vocabulary count; treatment < control on quality of conclusion, and vocabulary usage	

Note. C = contextualized instruction; I = integrated instruction. Comparison group attended traditional college-level courses but not developmental education.
"No-treatment," unless otherwise indicated, is defined as business as usual, i.e., following the conventional curriculum.