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Effects of inverted L2/Ln language pedagogy on student experiences and outcomes: The case of American Sign Language

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Abstract

Second language (L2) learning has largely occurred in the traditional lecture-based classroom setting. Studies show that the lecture format has an impact on student outcomes and perceptions of classroom learning. Negative impacts include insufficient time for reinforcement activities, reviewing lecture materials, and engaging in conversation between instructors and students. An innovative way to enhance L2 students' classroom outcomes and perceptions is the inverted classroom pedagogy. This study assesses whether the inverted pedagogy leads to more positive student perspectives and higher student outcomes compared to traditional pedagogy in L2 classrooms in American Sign Language (ASL). In this study, student outcomes and instructor and

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student perceptions of inverted pedagogy for ASL are assessed using a mixed method design with one controlled (traditional) and one experimental (inverted) advanced ASL class in a post-secondary setting. Results suggest that the inverted pedagogy is an approach that is as viable as the traditional approach for teaching and learning ASL as an L2 that enables students to engage in meaningful activities and conversations.

Keywords
American Sign Language, flipped class pedagogy, instructor–students interaction, questionnaire and survey, second language learning

I Introduction

Higher student outcomes and positive student perception of learning are two of the goals of any pedagogy, including the learning of second languages. Historically, second language (L2) learning has occurred in traditional lecture-based mode, consisting of pre-class readings, instructor-fronted classroom lectures and conversation activities, followed by review of materials, and ending with description of homework to reinforce the information taught. Students typically take homework home, where they watch videos (or listen to recordings) and complete assignments. Previous studies have reviewed the effects of the traditional pedagogical approach on student classroom outcomes and student/instructor perceptions of learning identified limitations in the traditional classroom structure, including lack of time and opportunity for review of materials and reinforcement activities (e.g. Bauer-Ramazani, Graney, Marshall, & Sabieh, 2015; Bergmann & Sams, 2012; Strayer, 2012). In these studies, some students felt that they were not given sufficient time to learn vocabulary and grammar or have conversations with each other using the target language. Instructors and students generally perceived that these characteristics of traditional classrooms limited their potential to achieve.

The issues of student classroom outcomes and perceptions of traditional classroom structures have also been observed in American Sign Language (ASL) classes at the secondary and post-secondary levels (e.g. Quinto-Pozos, 2011; Rosen, 2015). These issues were also noticed in ASL classes by several of the authors who were members of the ASL faculty at a mid-Atlantic area university, which provided the impetus for conducting this study. The above issues of student outcomes and perceptions of learning in traditional L2 spoken and signed classrooms suggested a need to investigate alternative pedagogical methodologies to determine if other instructional approaches may be better suited to learning languages. Inverted pedagogy is one approach that may address the above-mentioned problems and other issues in L2 classrooms (e.g. Bergmann & Sams, 2012). This study was designed to explore if the inverted pedagogy approach would impact student outcomes and learning experiences in ASL classrooms.

1 Theories underlying inverted pedagogy

An innovative pedagogical design called the ‘inverted classroom’ (also known as the ‘flipped classroom’) moves certain learning activities that have traditionally taken place

inside the classroom (e.g. lectures) to outside the classroom through multimedia technology, and other learning activities that have typically taken place outside of the classroom (e.g. reinforcement activities typically given as homework) into the classroom (Bauer-Ramazani et al., 2015; Bergmann & Sams, 2012; Lage, Platt, & Treglia, 2000). The sequence in inverted classrooms is the reverse of the sequence in traditional classrooms. In the inverted pedagogical approach, students view and can repeat their viewings of the lectures as homework outside of classrooms at times that fit their schedules before arriving to class. In class, they do assignments and engage in conversation activities.

The rationale for the inverted classroom approach is that more time is made available in class for instructor and student interactions, dialogues, and engagement in activities. The increased flexibility of class time may open up opportunities for in-depth and extended discussions of topical concepts, clarifications of hard-to-understand information, and investigations of questions related to content that the students learn from watching videos and doing assignments outside of classrooms prior to lessons (Bauer-Ramazani et al., 2015; Brooks, 2002). In addition, the inverted classroom is student-centered, providing a personalized and differentiated learning process whereby students learn at their own pace outside of classrooms, and engage in conversation activities in classrooms (Rajesh, 2015).

The inverted classroom approach incorporates concepts from the Communicative Language Teaching approach, Cooperative Learning approach, and the Output Hypothesis. The inverted pedagogical approach is built on the precepts of the Communicative Language Teaching approach, which posits that student-to-student interaction is an effective means to learn a language (Richards & Rodgers, 2014). The inverted approach is also built on the precepts of Cooperative (or collaborative) Learning, an educational model derived from theories of motivation and movement toward desired goals (Cannod, Burge, & Helmick, 2007). The foundation of cooperative learning is that when working together, students can achieve positive goals in learning course material. Dietrich and Urban (1998) contrast Cooperative Learning with traditional competitive learning where students work individually to learn the course material. Implementation of cooperative learning supports theories of social interdependence (Lewin, 1935, 1948) and positive interdependence among individuals whereby they perceive that they can achieve and reach their goals if they share common goals (Johnson, Johnson, & Smith, 2007), and not negative interdependence whereby they perceive that they can only reach their goals if other individuals fail to obtain their goals and obstruct each other's efforts to achieve the goals.

2 Studies in inverted pedagogy

Studies in the inverted pedagogical approach have been conducted in various disciplines in post-secondary classrooms in various countries such as Australia, Scotland, and the United States. The studies looked at student outcomes and perceptions of the inverted pedagogical approach. They employed quantitative and qualitative designs in classrooms teaching statistics (Strayer, 2012), software engineering (Cannod et al., 2007), physics (Bates & Galloway, 2012), and sociology (Forsey, Low, & Glance, 2013). Results showed many strengths for the inverted pedagogical approach, including increased

faculty–student interaction which enabled students to clear up confusion quickly, and instructor ability to monitor performance and comprehension in a timely manner. Students were able review videotaped lectures at their preferred times and as often as they wished. They were also able to develop communication skills and a command of the subject matter through small group interaction and the use of electronic media.

In inverted classrooms, input from the instructor is necessary but not sufficient for learning a language. The opportunity to produce conversations as output with instructor feedback is necessary in cooperative learning environments (Swain, 1985). Swain (1993) suggested different ways in which linguistic output may aid the learning of language. They include meaningful language use and provision of feedback when learners' utterances can be understood by negotiating meaning or supplying missing words (cf., Jacobs & McCafferty, 2006). Several researchers (Deen, 1991; Doughty & Pica, 1986; Kagan, 1992; Long, Adams, McClean, & Castanos, 1976; Magee & Jacobs, 2001) found that the students were able to use language for a variety of purposes (e.g. asking each other for clarification), with a variety of people, and had the opportunity to receive and incorporate feedback in a variety of contexts (Davis, 1997; Freeman & Freeman, 1994; Long & Porter, 1985).

a L2 studies in inverted pedagogy. The effectiveness of inverted-type pedagogy in L2 classrooms has recently been investigated. Several studies explored whether the inverted classroom structure generated higher student outcomes and positive instructor and student experiences than the traditional classroom structure. The L2 inverted pedagogy studies largely used field notes, questionnaires, and focus groups to investigate and compare between instructors' and students' thoughts and outcomes in inverted and traditional classrooms (see Strayer, 2012).

Researchers such as Sung (2015) studied student perceptions of inverted pedagogy in English as a foreign language (EFL) classrooms. Sung (2015) studied 12 college students' perceptions of an inverted classroom in a college-level EFL course in Korea. She employed students' 'thought papers', course evaluation results, and reflective learning logs as data. Results showed that the students had initial difficulties adjusting but viewed inverted learning positively. They found immediate and sufficient feedback from their instructors who gave them opportunities to discuss topics in depth. They also found that they had more time prior to class to develop their critical thoughts about lesson topics.

Other researchers such as Hung (2015) and Lee and Wallace (2018) studied student outcomes in and perceptions of inverted classrooms. Hung (2015) examined the effects of inverted classrooms on EFL students' academic performance, learning attitudes, and participation levels. She compared three different classroom settings: one inverted, one semi-inverted, and the third non-inverted, with 75 college freshmen in EFL classes in Taiwan. The data were based on questionnaires and assessments of student class performance at the beginning, middle, and end of the semester. Results showed no significant differences in student performance scores between traditional and inverted classrooms. However, the students in the inverted classroom attained the most improvement in performance scores from the first to the third assessment. They also earned higher mean scores in performance assessments than the mean scores of the students in the semi-inverted and non-inverted classrooms. In addition, results showed that the students in

full-inverted and semi-inverted classrooms performed better, demonstrated better attitudes, and made more efforts in their studies, than the students in traditional classrooms. Students in the fully-inverted and semi-inverted classes also valued the structured design of the learning materials and felt stimulated to become more active in learning compared to the students in the non-inverted, traditional classes.

Lee and Wallace (2018) studied 40 students in one inverted classroom and 39 students in one traditional classroom in College English 1 and examined their outcomes and perceptions over two consecutive semesters at a South Korean university. The data consisted of assessments of students' grades, their responses in three researcher-made survey questionnaires, and instructor notes on students' engagement in learning. Results showed that while higher mean scores in the examinations were attained by the students in the inverted classroom compared to the non-inverted classroom students, only the final semester scores were statistically significant. Questionnaire responses showed that most students in the inverted classroom enjoyed learning English. They were observed by the instructor to be more engaged in the learning process than students in the non-inverted classrooms.

The above studies in L2 classrooms showed that compared to traditional, lecture-based classrooms, the inverted classroom model generated higher student grades. The students were more prepared to attend classes, able to learn independently, and more engaged in classroom activities. They tended to prefer the inverted format over traditional lectures. There were increased interactions among students and instructors, a greater sense of community in inverted classrooms, and better opportunities for instructors to monitor student progress. In addition, Zainuddin and Halili (2016) reviewed 20 inverted classroom research articles from 2013–2015. Results from these studies generally showed that the inverted classroom had positive effects on students' outcomes and perceptions, including class engagement and interaction skills.

Zainuddin and Halili (2016) found several challenges for inverted classrooms, including untrained instructors and poor quality of technology, including equipment and video lectures. As Butt (2014) and McDonald and Smith (2013) noticed in their review of the inverted pedagogical approach in the classrooms in academic subjects other than L2, the above L2 studies employed questionnaires and interviews to discern student perceptions of the inverted approach. In addition, despite many positive findings with the inverted pedagogy, some issues remain unresolved. Strayer (2012) observed that some students in his statistics class had trouble making sense of learning activities, demonstrated lower levels of task orientation, and perceived that the class time devoted for activities was insufficient. However, these findings were somewhat mitigated by the other findings that students still preferred innovative approaches.

b Pedagogy in American Sign Language as L2. This study investigates the effectiveness of the inverted pedagogy for L2 classrooms in signed languages such as ASL. ASL is a natural, visual-gestural language used by deaf people across the United States, parts of Canada, and other countries. It is one of many signed languages used around the world. ASL contains vocabulary and grammatical systems with articulatory features that rely on a different modality than that of spoken languages such as English (Klima & Bellugi, 1979; Sandler & Lillo-Martin, 2006; Valli, Lucas, Mulrooney, & Villanueva, 2011).

While signed languages are gestural and visual, spoken languages are oral and aural. Modality differences are particularly reflected in the production of lexemes, inflections, polymorphemic classifiers and spatial constructions, grammatical bodily markers, and word order.

As Quinto-Pozos (2011) and Rosen (2015) found, ASL classrooms have largely followed the traditional approach. As mentioned earlier, the traditional classroom model that has been used in ASL classrooms has always been problematic for learners to gain communicative competence. There has been limited research to date comparing the effectiveness of various pedagogies to teach ASL. There is a paucity of applied theory and empirical evidence from the field of L2 acquisition in the implementation of ASL pedagogy. Research investigating the implementation of the inverted classroom, as a specific type of Cooperative Learning, may provide opportunities for more effective teaching and learning of L2 languages in general, and of ASL, in particular. This study was designed to explore if the inverted pedagogy model would impact the student outcomes and/or motivation differently than the traditional pedagogy model for L2 classes in signed languages.

II The study

Capitalizing on positive results from past studies, while attempting to resolve some of the pedagogical issues in L2 ASL classrooms, this study applied the inverted pedagogical approach in ASL classrooms. An innovative inverted-type pedagogy for an upper-level ASL class was designed (Fenicle, Cripps, Cooper, & Sever, 2019). The study compares the outcomes and perceptions of students in traditional and inverted classrooms in upper-level college ASL language classes. For the purposes of this study, the researchers developed the following hypothesis and question.

III Research hypothesis and question

The null hypothesis for the study assumed no difference between traditional classroom and inverted classroom in the objective data collected via students' grades and the scores from the College and University Classroom Environment Inventory (CUCEI) instrument. The research question, answered by subjective responses to a written questionnaire with students in the experimental group, asked how students' experiences using inverted pedagogy in ASL classroom compared to their past experiences in traditional classrooms.

IV Method

1 Research design

This study used a mixed method research design with one control group (a class taught using the traditional pedagogical approach) and one experimental group (a class taught using the inverted pedagogical approach). The mixed research design employed both qualitative and quantitative approaches and used data drawn from student grades and

responses to questionnaires. Quantitative data included dependent variables such as student grades and CUCEI responses, and the independent variable was the pedagogical approach with two conditions, traditional and inverted. Qualitative data included written questionnaire with open-ended questions pertaining to student experiences in the two pedagogical approaches. The results of both quantitative and qualitative analyses were used to compare student outcomes in and experiences of the experimental (inverted) and control (traditional) classrooms. The results from the quantitative approach were used to test the research hypothesis, and the results from the qualitative approach were used to answer the research question.

Both the quantitative data and the qualitative data underwent a triangulation process. Triangulation is a technique that analyses, interprets, and transposes data collected from different methods onto a phenomenon (Mertens & Hesse-Biber, 2012). In the triangulation process, the data from the quantitative approach is used to assess trends, distribution, and causation, and data from the qualitative approach is used to assess content of experiences and interpretations (Howe, 2012). In this mixed-methods study, the quantitative method is used to assess the effects of pedagogical formats on student outcomes and perspectives, and the qualitative method is used to assess student experiences in two different pedagogical formats. The aim of the triangulation process for this study is to provide a comprehensive picture of student performances, perspectives, and experiences particularly for students who underwent both traditional and flipped classrooms.

2 Setting

The research setting included two upper-level culminating ASL classes at a mid-Atlantic university. The students self-enrolled in classes and were not aware of the study or whether their class would use the traditional or inverted approach prior to the first day of class.

3 Participants

There were 22 students in the traditional class and 19 students in the inverted class, for a total of 41 participants. Students in the two classes were all female, traditional-aged college students, with some ethnic diversity. Ages ranged from 18 to 28 years, with 70% of participants 22 years old and younger. Most of the participants self-identified as Caucasian, followed by African-American and Hispanic/Latinx. All students had completed the prerequisite class with a grade of B– or better. Most of the students were classified as juniors or seniors. The university's Institutional Review Board approved the study which was introduced to the students on the first day of class, and students agreed to participate in the study and signed the informed consent forms. Anonymity and confidentiality of the participants were maintained in the researcher's locked file cabinet.

Two faculty members participated in this study. Both instructors were native signers, born into deaf families and raised with ASL as their first language at home and in school. Both were trained instructors holding Master's degrees in deaf-related fields, one in Deaf Education and one in Sign Language Instruction. The instructor for the traditional class was a female recent Master's degree graduate with approximately two years of teaching

experience in post-secondary level, and the instructor for the inverted class was a male with approximately eight years of teaching experience in both elementary (4 years) and post-secondary levels (4 years). It is important to acknowledge variables between the instructors such as gender difference and six-year difference in teaching experience.

4 Materials

Signing naturally: Vista sign language series (Smith, Lentz, & Mikos, 1988), emphasizing immersion experiences using the target language, was used as the curriculum for the two classes. The curriculum was commonly used for teaching ASL in high schools and colleges in the United States (Cooper, 1997; Rosen, 2015). This curriculum utilizes a 'functional-notional' approach, which is similar in many ways to the Communicative Language Teaching approach (Richards & Rodgers, 2014). The 'functional-notional' approach emphasizes functions and purposes of people's everyday communicative interactions. The curriculum is designed to help students establish and maintain social relationships, so that students have the opportunity to learn ASL through the context of natural communicative activities (Smith, Lentz, & Mikos, 1988). Level 3 of the *Signing naturally* curriculum was used in both traditional and inverted classrooms for this study.

The instructors also used PowerPoint presentations with video lectures that were designed and filmed by the faculty with a variety of signing models, and posted online using *Mediasite*, a video platform that assists instructors to create lectures with pre-recorded videos. It allows students to watch class lectures on their own time via mobile devices or computers (for further details, see mediasite.com). Only the experimental group had access to all signing models. See Figure 1 as an example of a lesson on *Mediasite*.

Student progress was assessed through 10 pop quizzes, three performance assessments in ASL literature, student self-reports from attendance at three Deaf social events, and five examinations. The assessment procedures used a variety of performance tasks, including receptive comprehension, students' paired dialogues, group debates, and narrative performances. Each of the assessment procedures is described below.

a Pop quizzes. The quizzes were developed by the instructors and were assessments of receptive skills. Each of the quizzes included multiple-choice questions where the instructor signed the sentence and the students chose one correct ASL glossed sentence that best represented the instructor's signing. A sample of a multiple-choice answers in ASL gloss as indicated in the first pop quiz is shown in Figure 2 from Appendix 1. Below is an example of a single question–answer pair.

ASL glosses comprise an intermediary writing system that includes capitalized English words representing ASL sign words and is written in ASL's morpho-syntactic structure (Supalla & Cripps, 2011; Supalla, Cripps, & Byrne, 2017). Due to the lack of conventional ASL written system, the rationale for using ASL gloss is that it reinforces students learning, understanding, and following the ASL morpho-syntactic structure via the written mode.

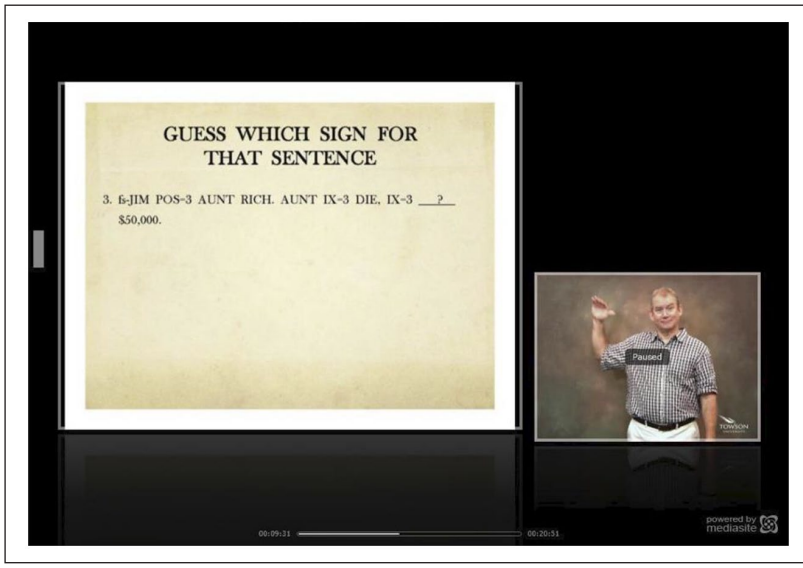

Figure 1. A sample of the online video lecture from the inverted classroom in *Mediasite*.

Directions: The instructor will sign a sentence and you circle which sentence below.

1. a. SHOULD DRIVE NEAR SCHOOL, CHILDREN PLAY, MUST DRIVE 20 fs-MPH BELOW.
   b. SUPPOSE DRIVE NEAR SCHOOL, CHILDREN PLAY, MUST DRIVE 20 fs-MPH BELOW.
   c. SUPPOSE DRIVE NEAR SCHOOL, CHILDREN PLAY, SHOULD DRIVE 20 fs-MPH BELOW.

Figure 2. Sample quiz questions.

b ASL literature. This assignment assessed students' narrative performances. Each student used ASL to tell stories on topics drawn from various units in the Level 3 *Signing naturally* textbook. The desired learning outcomes for this task were to promote students' use of their critical thinking to better understand literature in ASL and to expose students to the aesthetics (in addition to learning vocabulary and phrases) of ASL performers' work.

c Deaf events. Each student was required to attend four local or regional social events where signing deaf people congregate. They included Deaf Nights Out, Deaf and ASL theatrical performances, Deaf- and ASL-themed movie showings, captioned movie showings, interpreted sermons at churches and synagogues, and attendance at local Deaf clubs and recreational and athletic events. The students were required to write reports about their experiences and their reflections of the Deaf events. The desired learning

outcome for this task was to give the students experience learning ASL through interacting with ASL community members. This 'real time' learning experience has been shown to provide many benefits in learning the target language (e.g. Li & Jeong, 2020; Verga & Kotz, 2013).

d Examinations. The examinations covered material from the *Signing naturally* textbook. They covered the units in the textbook and included students' paired dialogues and group debates. Each of the above assessment procedures was graded using published rubrics (Beginning Exam: *Classroom communication scale*, Hoskins & Noel, 2011; Midterm Exam: *Assessment rubric: Team debate*, Arlington Education & Employment Program, n.d.; Final Exam: *Student oral language observation matrix*, Parker, Dolson, & Gold, 1985).

Students in both traditional and inverted classrooms were asked about their perceptions of the pedagogy approach through which they learned ASL during the experimental semester. Student perceptions of the pedagogical approaches were assessed using the questionnaire instrument, College and University Classroom Environment Inventory (CUCEI). The CUCEI was developed by Fraser and colleagues for use in higher education (Fraser, Treagust, & Dennis, 1986; Treagust & Fraser, 1986), and was used in Strayer's (2012) study. Its purposes were to assess students' perceptions of their actual learning environment and preferences of the type of learning environment. The instrument includes scales that capture student perceptions of classroom and teaching innovation. As shown in Appendix 2, the items that are covered in the CUCEI pertain to personalization, innovation, student cohesion, satisfaction, task orientation, cooperation, and individualization. Specifically, students had the opportunity to provide feedback regarding personalization in student–instructor interaction and personal welfare; students' involvement in class discussions and activities; cohesion in student–student relationship and personal growth; student satisfaction and enjoyment of class; instructor innovation in class activities, techniques, and assignments; individualization in students' learning; and task orientation in the course design, system maintenance and change (Treagust & Fraser, 1986).

Treagust and Fraser (1986) described the administration and scoring of the CUCEI. The items are arranged in a cyclical order in conjunction with the seven categories of the CUCEI, namely, Personalization, Involvement, Student Cohesiveness, Satisfaction, Task Orientation, Innovation, and Individualization. Students were asked to circle the responses to the items, which included Strongly Agree, Agree, Disagree, and Strongly Disagree. The responses were scored 1, 2, 4, and 5 for the items that were not underlined in the CUCEI instrument and in reverse order for the items that were underlined. The items that were either omitted or invalidly answered were scored 3 (ibid, p. 7). For further information on the CUCEI instrument, the reader is referred to Fraser et al. (1986). The CUCEI instrument has demonstrated strong reliability and validity and has long been used as a classroom environment assessment tool (Fraser, 1998). The internal consistency reliability for the seven scales has been reported in several studies to range in Cronbach's alpha coefficients from 0.70 to 0.90, which were acceptable in multiple studies (Fraser, 1998; Fraser et al., 1986).

However, Logan, Crump, and Rennie (2006) found a different outcome for using this instrument in their study measuring the classroom environment perceptions of students

in computing classrooms in secondary and tertiary institutions (for their findings, see also Nair & Fisher, 1999, 2000). Acknowledging the differences between these two groups' outcomes in terms of psychometric properties, the authors of this study administered this instrument despite insufficient instruments available to measure the perceptions of classroom environment. Data from the CUCEI were used to report student perceptions of the inverted pedagogy. The authors of this study did not pursue the statistical work to verify the reliability and validity for this instrument as it is outside the scope of this article.

A written questionnaire was developed for the students. The purpose of the questionnaire was to assess student experiences in the inverted classroom as compared with their previous experiences in traditional classes. Since the questions required comparisons of perceptions and experiences the students had in both traditional and inverted classrooms, only data from the students in the inverted classroom were used for this study. The following were the questions that were asked of the students in the inverted classroom:

1. Do you feel that you were prepared to succeed in this advanced ASL 5 class? Please explain.
2. What did you learn from this course?
3. Did you have any concerns about this course? If so, did they materialize?
4. How were your expectations regarding teacher–student interaction in this course met? Please describe your experience regarding your interaction with the instructor.
5. How were your expectations regarding student–student interaction in this course met? Please describe your experience regarding your interaction with your classmates.
6. Were you satisfied with the amount of class time spent communicating with students in ASL?
7. Were you satisfied with the amount of class time spent communicating with the instructor in ASL?
8. In this ASL class, approximately what percentage of the total in-class time was spent communicating in ASL with your instructor?
9. In this ASL class, approximately what percentage of the total in-class time was spent practicing ASL with other students?
10. How was this class different from your previous ASL classes?

This qualitative measure was intended to capture expectations, experiences, and student thoughts regarding the instructional approaches and were used to supplement the students' course grade performance and CUCEI results to assess the effectiveness of the inverted pedagogy for ASL.

5 Procedure

In preparation for this study, the first author developed the guidelines for implementing the approach in the two classrooms. The faculty teaching the traditional and inverted classes developed and used the same PowerPoint lectures using the Level 3 of the *Signing*

naturally curriculum (Mikos, Smith, & Lentz, 2001). They taught the courses using the same textbooks and assessment rubrics (see Fenicle et al., 2019 for further description of the development of the ASL inverted pedagogy), however, the instructor in the traditional class presented the lectures live in class, and the instructor in the experimental class pre-recorded lectures on video for the students to watch at home before each class.

Over the course of the study, students in both traditional and inverted groups attended class three times per week for 14 weeks. Both classes used Level 3 of the *Signing naturally* curriculum. The control group received their instruction in the classroom through lectures and PowerPoint presentations during class time; these PowerPoint presentations (without the accompanying lectures) were also posted on an electronic platform, Blackboard, to provide the opportunity for review. For the experimental group, the instructor supplemented the PowerPoint presentations with instructor video lectures on *Mediasite*. The students in the control group only had access to the static PowerPoint presentations for review, while students in the experimental group also had 24/7 access to videotaped lectures. The videotaped lectures were supplemented by in-class reviews and activities. These experimental classes still included face-to-face instruction and should not be misconstrued as fully online courses.

Class periods were used differently in traditional and inverted classrooms. In the traditional classroom, class periods were used for a combination of lecture and activity (approximately 40 minutes lecture and 10 minutes activity per class). In the inverted pedagogy, students were required to watch two 20-minute video lectures that covered the course materials as homework before class time each week, and class periods were used for communication activities and practice (approximately 40 minutes per class), and instructor feedback (approximately 10 minutes per class at the beginning and throughout the class period as needed).

The students in both groups completed the same quizzes, ASL literature performances, attendance at Deaf events, and exams designed to test their sign proficiency. The CUCEI (Fraser et al., 1986) was administered to the students in the traditional and inverted ASL classes at the end of the semester to assess the quality of their interactions with the instructor and other students, and satisfaction with the learning environment in their classrooms. The post-study written questionnaire that was developed by the authors focused on student experiences with the two instructional methods and was completed at the end of the semester only by students from the inverted classroom.

6 Data collection and analysis

The mixed design methods using both quantitative and qualitative approaches that were employed for this study allowed for an analysis of all aspects of the two pedagogical approaches (Creswell & Creswell, 2017; Strayer, 2012). Two primary sources of data were collected for quantitative analyses. The first source was student grades from the quizzes, ASL literature, Deaf events, and examinations. The second source was the CUCEI. Comparisons were made by classroom type to gauge student performance and perceptions. T-tests and MANOVA were employed as the statistic to assess student performance in quizzes, examinations, and the CUCEI. One source of data, the questionnaire given to the students in the experimental group, was used for qualitative analysis.

Responses to the written questions were content-analysed by an inductive process; they were coded and grouped into categories with common themes, and the thematic validity of the categories was determined by agreement among the authors of this study (e.g. Charmaz, 2006; Corbin & Strauss, 2008).

V Results

The results of student grades and perceptions of the two instructional modes are shown in two parts. The first part provides quantitative results from student CUCEI and class grade scores. The second part shows the qualitative results from the inverted classroom student questionnaire.

1 Quantitative Results

To ensure that the CUCEI actually measured what it was purported to measure, that is, whether the instrument was reliable for measuring students' perceptions for this study, a reliability analysis using Cronbach's alpha was conducted. The results show that the Cronbach's alpha was 71.5, which is considered an adequate figure for the coverage of the instrument for this study.

The authors also looked at the main effects of instructional method on students' CUCEI scores in both traditional and inverted classrooms. This includes assessment of the differences in mean scores between the traditional and inverted groups and the significance of the differences in group means by instructional method. The table in Appendix 2 shows MANOVA results for the two instructional groups using the CUCEI. This table shows that the instructional method had no statistically significant effect on students' mean scores for most of the CUCEI categories, however, the results of the instructional groups significantly differed on some items. Results of the Cohen's *d* statistic showed that the effect size of the difference between the two instructional group means for each CUCEI item ranged from small to medium. This suggests that student perceptions of the personalization, innovation, student cohesion, satisfaction, task orientation, involvement and individualization did not significantly differ between and were not largely affected by the two types of instructional method. Below is the breakdown of the results by CUCEI category.

a Personalization. There was no statistically significant difference between the traditional and inverted groups in any of the items of Personalization. Both traditional and inverted students agreed that the instructors in their classes were considerate of students' feelings, talked individually with students, went out of their way to help students who had trouble with their work, were interested in students' problems, and were friendly and considerate towards students. The students also agreed that the instructors frequently moved around the classroom to talk with students.

b Involvement. There were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for others. Students in both traditional and inverted groups agreed in their perceptions that the

instructor in their class did not talk more than they listen and did not dominate class discussions. They also agreed that the students did not 'clockwatch' in class. However, there were significant differences in the perceptions between the traditional and inverted groups on their own class performance. The traditional group believed that the students in their group, more than the inverted group, put effort into class participation, paid more attention to what others were saying, and presented their work more frequently to the class.

c *Student cohesiveness.* There were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for other items in the category of Student Cohesiveness. Students in both traditional and inverted groups agreed that the students knew each other by first names, that friendships were made among the students in the class, that the students in the class got to know each other well, and that they had adequate chances to get to know one another in class. They also agreed that the class was not made up of individuals who did not know each other well. Significant differences did appear in perceptions whereby students in the inverted group believed that the students in their group were less interested in getting to know other students than the traditional group.

d *Satisfaction.* In the category of Satisfaction, there were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for other items. Students in both traditional and inverted groups agreed in their perceptions that the students had a sense of satisfaction after class, they enjoyed going to class, that their classes were interesting, and that the students were satisfied with what was done in the class. They also agreed that the classes were not a waste of time, and that classes were not boring. However, there was a significant difference in the perceptions; the traditional group believed that the students in their group looked forward to coming to class more than their counterparts.

e *Task orientation.* There were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for other items in the category of Task Orientation. Students in both traditional and inverted groups agreed that getting a certain amount of work done in class was important, that class assignments were well-explained, and that the activities in their classes were clearly and carefully planned. They also agreed that their classes were not disorganized and that the instruction did not get sidetracked. However, the traditional group believed and that the students in their group, more than the inverted group, knew exactly what had to be done in their classes.

f *Innovation.* In the category of Innovation, there were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for other items. Students in both traditional and inverted groups agreed in their perceptions that new ideas were tried in their classes, and that new and different ways of teaching were used in their classes. They also agreed that their instructors implemented innovative activities for students to do. They also agreed that the same activities

were not repeated in every class. However, students in the inverted group believed that the teaching approaches in their class were characterized by innovation and variety more so than in the traditional class.

g Individualization. There were no statistically significant differences between the traditional and inverted groups for some items, but there were significant differences for other items in the category of Individualization. Students in both traditional and inverted groups agreed that all students were expected to do the same work, in the same way, and within the same time frame. They also agreed that the students in their groups were generally allowed to work at their own pace, allowed to choose activities, and had opportunities to pursue their particular interests in their classes. They agreed that their instructors' teaching approaches allowed each student to proceed at their own pace, and that the instructors decided what will be done in their classes. However, the traditional group felt more strongly than the other group that they had a say in how class time was spent.

2 Student grades

To analyse student grades, the authors repeated the same procedure used for the CUCEI. The table in Appendix 3 provides statistical information on students' grades for both instructional methods. This table shows the differences in student grade means for the different learning performance tasks in two instructional groups. It also shows that student grades did not significantly differ between the two instructional methods for pop quizzes, ASL literature, or Deaf events. There were no statistically significant differences between the traditional and inverted groups in 9 out of 10 pop quizzes, 2 out of 3 ASL Literature tasks, 2 out of 3 Deaf event reflection papers, and 1 out of 5 examinations. There were statistically significant differences between the traditional and inverted groups, with the inverted group attaining higher scores than the traditional group in pop quiz #9, and examinations #1 and #5. The traditional group scored significantly higher than the inverted group in ASL Literature task #2, Deaf Event reflection paper #2, and examinations #2 and #3. Results of the Cohen's *d* statistic show a range of medium to large difference in effect sizes between the two instructional groups regarding student grades. Analysing the performances of individual students in each group, the significant differences were largely due to some students in each group not following instructions or not fulfilling the requirements of the assessment procedure, rather than the systematic effects of instructional method on the assessment tasks for the students to perform.

The findings regarding student assessments were mixed. Based on individual student performances in each group, the pattern of exam results for each task in each assessment procedure suggests that traditional pedagogy may have helped some students, and the inverted classroom pedagogy may have helped other students. The variegated results in student performances for different tasks suggest that there was no overall advantage for using a particular instructional mode for a specific task. The overall final student grades did not differ by instructional method. This suggests that the instructional method had no statistically significant effect on overall student grade scores.

3 Qualitative results

As mentioned earlier, the post-study written questionnaire was administered to the students in the inverted classroom after they completed the course. They were asked about their experiences in the inverted classroom and how they felt it compared with their past experiences in traditional classrooms. Student responses to the questions were categorized into student learning goals, quality and variety of learning activities, time using ASL in class, interactions, and any concerns that they may have about the inverted class. Results of this questionnaire are described below.

Most students in the inverted classroom cared more about improving their ASL fluency in receptive, productive, and conversation skills than increasing their vocabulary, developing classifier skills, and improving confidence. One student reported that prior to her enrollment in the inverted class she expected that she would learn, 'how to have conversations about specific topics: health, cars, finances.' Another student indicated her goals were '. . . to improve my skills – linguistics too.' The responses from the students suggested that prior to enrollment in the inverted classroom, they aimed to improve fluency in receptive and expressive conversational skills, to interact with other students, and have conversations about the topics that were covered in class.

The students in the inverted, experimental classroom were asked to compare their experiences in the inverted class to learning and activities in previous traditional classes. Students in the experimental group were generally satisfied with their experiences in the inverted classroom. They felt that they were given more responsibility for their learning compared to their expectations prior to enrollment. They experienced increased opportunities for conversation, the use of ASL, and the pacing, rigor, challenge, and intensity of learning. Compared with traditional classes, the students found that the inverted classroom offered 'more open conversations and less sitting and learning vocabulary.' Another added that 'having online videos of other teachers signing material made me more comfortable with signing variety.' One explained that 'this class focused on sharing opinions about topics in detail,' and another student added that it was 'more advanced, but also [offered] more time to practice.' In the inverted class, one student observed that there was 'more interacting with students and learn(ing) from videos independently rather than (the) instructor teaching everything,' while another stated that there were 'more videos and less teaching.' One student said the inverted class was 'more intense', and another said the class 'was more fast-paced.' One student explained that the inverted class 'was more ASL-based and strictly signing which helped improved everyone's skills.'

The students felt that their learning goals were met in the inverted classroom. One student commented that she 'learned how to describe things better and how to improve my communication skills.' Another said that she 'learned new vocabulary, [developed] better conversation skills, and [learned] some classifiers,' while another was happy to have 'more expansion with classifiers.' The students also shared that they learned more content and how to talk about it. One wrote that the class offered 'more real-life applications of the language,' and another enjoyed learning 'how to discuss real-world problems.' The students acknowledged learning vocabulary for content such as 'money, accidents, health, diseases,' and one indicated that she 'learned about the human body, how to discuss [a] car crash, horse/bike riding, etc.' Another added that she 'learned

about the body, cars, houses and how to explain processes and to clarify signs.' One student concluded, 'All was good. We worked together and accomplished goals.'

The inverted classroom appeared to provide more opportunities for students to practice and improve their sign vocabulary and conversation skills. One student acknowledged that she was 'not great with depicting verbs, I'm glad that I had the chance to practice that.' Another student learned 'how to approach explanations. I'm still not great if I don't have time to prepare, but I feel more comfortable now. I practiced making my signs fit better with what I'm trying to explain.'

Some students expressed how they increased their confidence in learning and using signs to describe and communicate with each other. One said that she 'felt confident and I feel that I've improved in my communication skills.' Another shared that she 'gained more confidence in my ability to sign stories, [and] have an extended conversation in ASL for a long time [sic].' The class helped one student learn not to 'sign word for word but rather the concept of the idea.'

The students in the experimental group were further asked about their interactions with other students and their instructors. These students found instructor–student interactions to be friendly and respectful, and that their instructor was supportive, approachable, and caring, and helpful. They felt that their classmates were nice, helpful and engaged in group conversation and work. One said that there was 'lots of helpful interaction between students,' another said that 'everyone supported each other,' and still another added that 'my classmates were encouraging.' One student found the experience beneficial since she and her classmates 'did a lot of group work and group presentations which helped a lot because you learn a lot from classmates.' One student agreed that 'student–student interaction was great. Everyone supported one another. If a person didn't know a sign, a peer was always helpful.' One exclaimed, 'I love my classmates!! Great class discussions and socialization.' One student explained, 'With our class being small and knowing everyone in the major, it's easy to get along and know each other well, and not be afraid to ask each other for help.' One commented, 'It was nice to sign with different people.'

The students were also asked about the time they spent using ASL in their classes. Students felt that they spent more time using ASL with instructors more than with students. Students reported that they used ASL in a range of 40 to 50 percent of the class time with their instructor and about a quarter of class time with other students. Nonetheless, they reported more satisfaction with 'the time spent communicating with students in ASL' and 'the time spent communicating with instructor in ASL' compared to experiences in the traditional classrooms. When students compared their inverted classroom experiences with their prior enrollment in traditional classrooms, they acknowledged that they had more time in the inverted environment to study and interact with other students outside of class time, help each other, and develop relationships. During class time, they experienced more positive interactions with their classmates. They felt motivated and engaged in partner and group work.

There were some students who did not see any difference in their experiences between traditional and inverted classrooms. One wrote, 'I'm not really sure; seems the same to me,' while another added that the inverted class was 'not so much [difference], more advanced and detailed topics and conversation.' Another student observed, that 'it was not very different. I like the way (university) ASL classes are run.'

While the students were satisfied with the inverted classroom set-up, there were three students who expressed concerns. They wished that they had given themselves more time to watch the videos, and desired more review time with the instructor. One student wished that 'there was more in-class interaction with each other.' Another student added that she wanted to have 'a lot of student–student time to practice new skills learned.' Still another student wished that she could have had more 'one-on-one advice' with the instructor. Other than these students, the students in the inverted classrooms were largely satisfied with the amount of time spent in communicating with their instructors and other students in ASL.

The other criticisms were few, and they were largely due to student personality differences and lack of participation. One student confided that 'as in every class, there can be one or two students who just never get along. I found the majority of my peers to be willing to participate in group projects.' Another student confided that '1 on 1 teacher–student interactions could have been more frequent, but that was partly b/c [sic] of my lack of effort to communicate often as I could have.'

VI Discussion

This mixed methods study compared student experiences and outcomes in inverted and traditional classrooms. The results of this study were used to assess the research hypothesis and answer the research question stated above, and were compared with the findings in past studies reviewed above. This study utilized student grades and written questionnaire like Butt (2014) and McDonald and Smith (2013) and added the CUCEI as a measure of student perceptions, which was not used in the past L2 studies.

The findings in this study support the null hypothesis that, except for a few items, there was largely no difference between traditional classroom and inverted classroom in student overall course grades and students' CUCEI scores. While there were statistically significant differences in a few of the categories that measured student grades, the impact of pedagogy method on the overall student course grades was negligible. The study's findings regarding the CUCEI, student grades, and student post-study questionnaire are discussed below.

1 CUCEI

This study found no statistically significant differences in student perceptions of many aspects of traditional classrooms compared with their perceptions of an inverted classroom. The students in both instructional groups experienced their instructors as approachable, considerate, respectful, helpful, innovative, and supportive. Students perceived that their instructors utilized different activities and methods for teaching and learning, and established clear class goals and objectives. The students in both groups equally agreed that their classmates were cooperative, friendly, interactive, and were able to work together in group conversations, activities, and projects. Students in both groups felt that they participated, were oriented to learning tasks, learned at their own pace, and were able to ask for assistance from instructors and classmates. They largely were satisfied with their courses, instructors, and classmates.

However, the two instructional groups differed in some of the CUCEI categories. The traditional group perceived that they put more effort into learning, looked forward

coming to class more, were more confident in what they were doing in the classroom, and had more input in how class time was spent. The experimental group perceived that their classmates were less interested in getting to know other students, but that their classes were innovative and varied. Students in the inverted classrooms appeared to feel more motivated, satisfied, involved and individualized in their learning than the students in the traditional classroom. The students in the traditional classroom felt that they were involved and organized more than the students in the inverted classroom.

The findings in this study are largely unequivocal. As previously mentioned, no previous L2 study has used the CUCEI as an instrument to measure qualitative findings on student perceptions. The current findings do not support the findings from Hung (2015), Zainuddin and Halili (2016), Lee and Wallace (2018) which indicated that the inverted classroom had positive effects on students' perceptions.

2 Student grades

There were largely no statistically significant differences between the two groups in student grade outcomes for the pop quizzes, ASL literature assignments, Deaf events reflection papers, and examinations. However, there were statistically significant differences between the traditional and inverted groups in some of the assessment tasks. The pattern of assessment results suggests that the students in the inverted group performed better than the students in the traditional groups in assessments that involved in games, stories, dialogues, and debates. The students in the traditional group performed better than the students in the inverted group in assessments that involved descriptions of environments and events. The variegated results in student performances for different tasks suggest that there are advantages for using a particular instructional mode for a specific task.

The inverted pedagogy was found to have positive effects on student grades in studies by Hung (2015), Zainuddin and Halili (2016), and Lee and Wallace (2018). The current study does not support the findings of these past studies. This study found no statistically significant difference in student grades between the traditional and inverted classrooms, but identified some statistically significant differences in some of the assessments. The differences that were significant between the two instructional groups were for the tasks that involved descriptions and debates, with the former being favored in the traditional group and the latter in the inverted group. Since descriptions require vocabulary and sentences, the instructor in the traditional group was afforded the time to instruct the students. In contrast, debates, where students argue for points of views, and which require conversations, may be favored in the inverted group which provided the students with time and opportunity to work on conversations. This suggests that there were certain tasks that the students could perform well under a certain instructional pedagogy, and that different pedagogies may work well for different tasks with individual students.

3 Student post-study questionnaire

Students in the inverted classroom were asked to compare their experiences in the inverted classroom with traditional classrooms from their past experiences. Since this study assessed the effectiveness of the inverted pedagogy, only the students from the inverted group were administered the questionnaire. Results from the questionnaire with

the students in the inverted classroom show that they expressed satisfaction with the support and encouragement they received from their instructor, and felt more responsible for their learning and participation in classrooms and the congeniality and cooperativeness with their classmates, as compared with their prior experiences in traditional classrooms. They reported learning more vocabulary and conversation structures in the inverted classroom than in previous traditional classrooms. They interacted more with their teacher and students in the inverted classroom than in previous traditional classrooms. There were a few who did not see any differences in their experiences in the inverted classroom compared with previous traditional classrooms. There were some who had difficulties interacting with classmates due to motivation and personality differences.

Previous studies of the inverted instructional mode (Bates & Galloway, 2012; Cannod et al., 2007; Forsey, Low, & Glance, 2013; Strayer, 2012; Sung, 2015) generally found increased faculty–student interaction and student engagement in classroom activities in inverted classrooms compared to traditional classrooms. In support of these studies, this study found that students in the inverted classroom reported pleasant experiences in interactions with the instructor and classmates, including receiving instructor feedback, and having more time and opportunities to discuss topics in depth.

However, the findings in this study did not agree with the findings of Cannod et al. (2007), Bates and Galloway (2012), Forsey et al. (2013), and Sung (2015) regarding differences between traditional and inverted classrooms in student engagement and interaction in classroom activities. In both inverted and traditional classrooms in this study, the students were able to watch *Signing naturally* videotapes from the student workbook. The students in the inverted class had an additional advantage in being able to review videotaped lectures. They were also able to develop communication skills and a command of the subject matter through group interaction and the use of electronic media.

In general, the results of this study imply that the pedagogy impacted students' CUCEI and grades similarly. In both pedagogies there were faculty–student interactions. The instructors were able to monitor student comprehension in a timely manner. The students were able to develop communication skills and a command of the subject matter. In addition, in both pedagogical approaches, there was student recognition of the value of learning with partners, participation in activities which increased student confidence, the flexibility of having content available online, an increase in the quality of both contact with the instructor and in-class discussions, and a greater sense of community. As reported above, students felt prepared for, and were satisfied with, their learning experiences.

VII Conclusions

1 Limitations of the study

Some of the limitations of this study include the size of the study, which included only one control class and one experimental class, and the use of two different instructors. That the findings in this study did not support the findings in past studies suggests several possible factors.

One possible set of factors pertain to the instructors. Instructors varied with regard to experience, personalities, and commitment to the flipped approach. The personality of

the course instructors may cause different factors in this study. One is that it may have caused extraneous effect as one might become moderator for another. The different personalities and teaching styles of the instructors may also have created certain classroom dynamics that may have motivated some students and demotivated other students to participate in class activities. Another factor may have been the inclusion of only one gender (of a binary gender system) among the participants. Gender has been found to affect language acquisition (van der Silk, van Hout, and Schepens, 2015). While this provides a degree of control, it may have affected the results in terms of diversity.

Another set of factors pertains to the nature of the curriculum used in both traditional and inverted classrooms. The *Signing naturally* curriculum emphasizes the opportunity and time to have conversations with their classmates and instructors. That the curricular emphasis on conversation opportunities were rendered in both classrooms may have obviated potential differences in overall group results. The second factor that was beyond the control of the study was the individual experiences of the students. It is possible that students in either classroom may have signed with deaf and signing friends and/or relatives during the semester which may have impacted their signing skills. Additionally, students may have been self-motivated to varying degrees to improve their ASL skills. Their course grades may have improved independently of the instructional method that was used in their classrooms.

There were some challenges in both traditional and inverted classrooms. For example, instructors in this study felt that the assigned 50-minute class period three times per week was not enough time to accomplish their goals and would have preferred a 75-minute class period twice per week. Additionally, there were a few instances of technology slowdowns and breakdowns, particularly in the inverted classroom, which were out of the control of its instructor, supporting the findings in Zainuddin and Halili (2016).

2 Suggestions for future study

There are several suggestions for future investigation which could build on the findings of this study. The study could be replicated by using the same instructor for both instructional and traditional classes to limit the confounding variables and control for the skill, experience, personality, and timeliness of the instructor, and to focus on the interaction between instructional methods and student performance. This study could also be repeated with a larger population, using more than one class, and students of varying genders, for each pedagogical method. Another area in need of investigation is the impact of instructional methods on student performances in different levels of L2 classes and across several semesters, and at different educational institutions.

3 Summary

The results of this study suggest that the inverted pedagogy is an approach that is as viable as the traditional approach for teaching and learning signed languages such as ASL, enabling students to engage in meaningful activities and interactions. The comparisons of qualitative and quantitative measures show that in some areas the traditional pedagogy was better than the inverted pedagogy, while in other areas, the reverse was found. The overall results suggest that the effectiveness of an instructional model is shaped by lesson

content, student preferences, and learning styles. Replication of this study with a larger population sample using the same instructor for both groups is encouraged.

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Appendix 1

Sample quiz questions

ASL V
Quiz 1, Unit 24
(.25 point each)
____ / 1.5

Name:
Date:

Directions

The instructor will sign a sentence and you circle which sentence below.

1. a. SHOULD DRIVE NEAR SCHOOL, CHILDREN PLAY, MUST DRIVE 20 fs-MPH BELOW.
   b. SUPPOSE DRIVE NEAR SCHOOL, CHILDREN PLAY, MUST DRIVE 20 fs-MPH BELOW.
   c. SUPPOSE DRIVE NEAR SCHOOL, CHILDREN PLAY, SHOULD DRIVE 20 fs-MPH BELOW.
2. a. HERE fs-MD FREEWAY SPEED, LIMIT 70 fs-MPH. LIMIT-OVER, !GET-TICKET! CAN.
   b. HERE fs-MD FREEWAY SPEED, LIMIT 80 fs-MPH. LIMIT-OVER, !GET-TICKET! CAN.
   c. HERE fs-MD FREEWAY, 80 fs-MPH. LIMIT-OVER, !GET-TICKET! CAN.
3. a. THERE JAPAN (2h)HOLD>HAND WAVE>NO !WRONG!
   b. THERE JAPAN (2h)HOLD>HAND FINISH !WRONG!
   c. THERE JAPAN (2h)HOLD>HAND WAVE !WRONG!
4. <rs:child (2h)V-CHILD>_____>ADULT> <rs:adult (2h) V-ADULT>LOOK-AT>CHILD>.
   a. LOOK-DOWN
   b. LOOK-AT
   c. LOOK-UP
5. (2h) R-CARD>FLIP>_____
   a. FACE>OVER
   b. FACE>DOWN
   c. FACE>UP
6. WHO. _____ CARD, FINISH WIN.
   a. GRAB
   b. COLLECT>ALL
   c. GONE

Appendix 2. Main effects of instructional method on each item in College and University Classroom Environment Inventory (CUCEI).

Scale	Traditional (n = 22)		Inverted (n = 19)		F	p	Cohen's d
	Mean	SD	Mean	SD			
Personalization:							
1. The instructor considers students' feelings							
	4.91	0.294	4.89	0.315	0.091	.881	0.304
8. The instructor talks individually with students.							
	4.73	0.456	4.63	0.496	1.553	.523	0.475
15. The instructor goes out of his/her way to help students.							
	4.77	0.429	4.68	0.478	1.524	.535	0.452
22. The instructor helps each student who is having trouble with the work.							
	4.50	0.740	4.53	0.513	0.884	.897	0.645
29. The instructor seldom moves around the classroom to talk with students.							
	2.18	1.622	1.74	1.240	3.492	.336	1.458
36. The instructor isn't interested in students' problems.							
	1.24	0.436	1.58	1.121	5.948	.205	0.834
43. The instructor is unfriendly and inconsiderate towards students.							
	1.00	0.000	1.11	0.323	13.648	.114	0.786
Involvement:							
2. The instructor talks rather than listens.							
	2.14	1.125	1.89	0.737	1.818	.429	0.966
9. Students put effort into what they do in classes.							
	4.64	0.492	4.05	0.848	0.059	.009**	0.680
16. Students 'clockwatch' in this class.							
	2.14	1.125	1.84	0.765	1.189	.341	0.976
23. Students in this class pay attention to what others are saying.							
	4.64	0.492	4.21	0.918	2.273	.067	0.721
30. Students seldom present their work to the class.							
	2.43	1.207	1.84	0.898	6.613	.092	1.072
37. There are opportunities for students to express opinions in this class.							
	4.62	0.498	4.68	0.478	0.707	.676	0.488
44. The instructor dominates class discussions.							
	1.86	0.990	1.94	0.725	2.013	.775	0.882
Student cohesiveness:							
3. The class is made up of individuals who don't know each other well.							
	1.55	0.739	1.79	0.713	0.456	.290	0.727
10. Each student knows the other members of the class by their first names.							
	3.59	1.098	3.84	1.214	0.036	.491	1.153
17. Friendships are made among students in this class.							
	4.68	0.477	4.58	0.507	1.533	.508	0.491
24. Students don't have much chance to get to know each other in this class.							
	1.86	0.990	1.79	0.918	0.041	.806	0.957

(Continued)

Appendix 2. (Continued)

Scale	Traditional (n = 22)		Inverted (n = 19)		F	p	Cohen's d
	Mean	SD	Mean	SD			
31. It takes a long time to get to know everybody by his/her first name in this class.							
	2.57	1.326	2.11	1.243	2.455	.260	1.287
38. Students in this class get to know each other well.							
	4.43	0.507	4.63	0.496	0.550	.209	0.502
45. Students in this class aren't very interested in getting to know other students.							
	1.55	0.739	2.00	0.840	0.705	.077	0.786
Satisfaction:							
4. The students look forward to coming to classes							
	4.55	0.510	4.16	0.501	3.637	.019*	0.506
11. Students are dissatisfied with what is done in the class.							
	1.59	0.908	1.58	0.507	2.636	.960	0.750
18. After the class, the students have a sense of satisfaction.							
	4.50	0.740	4.47	0.513	0.884	.897	0.645
25. Classes are a waste of time.							
	1.18	0.395	1.16	0.375	0.158	.844	0.386
32. Classes are boring.							
	1.33	0.483	1.47	0.583	2.092	.378	0.497
39. Students enjoy going to this class.							
	4.71	0.463	4.53	0.513	3.875	.231	0.487
46. Classes are interesting.							
	4.59	0.503	4.44	0.511	0.175	.369	0.507
Task orientation:							
5. Students know exactly what has to be done in our class.							
	4.45	0.510	4.05	0.970	2.102	.098	0.758
12. Getting a certain amount of work done is important in this class.							
	4.36	0.953	4.53	0.513	3.835	.510	0.782
19. The group often gets sidetracked instead of sticking to the point.							
	2.41	0.908	2.37	1.065	0.133	.896	0.984
26. This is disorganized class.							
	1.41	0.503	1.47	0.772	1.276	.750	0.642
33. Class assignments are clear so everyone knows what to do.							
	4.10	0.831	4.32	0.478	0.312	.317	0.687
40. This class seldom starts on time.							
	2.53	1.250	3.42	1.017	1.241	.018*	1.146
47. Activities in this class are clearly and carefully planned.							
	4.41	0.503	4.22	0.548	0.515	.269	0.524
Innovation:							
6. New ideas are seldom tried out in this class.							
	2.36	1.093	2.26	0.806	3.479	.743	0.971

(Continued)

Appendix 2. (Continued)

Scale	Traditional ($n = 22$)		Inverted ($n = 19$)		F	p	Cohen's d
	Mean	SD	Mean	SD			
13. New and different ways of teaching are seldom used in this class.							
	2.45	1.011	2.11	0.737	6.229	.220	0.895
20. The instructor thinks up innovative activities for students to do.							
	4.18	1.006	4.37	0.761	0.661	.513	0.901
27. Teaching approaches in this class are characterized by innovation and variety.							
	3.82	1.097	4.37	0.496	4.912	.051	0.873
34. The seating in this class is arranged in the same way each week.							
	4.62	0.740	4.58	0.507	0.251	.844	0.640
41. The instructor often thinks of unusual class activities.							
	2.95	1.214	2.59	1.121	1.091	.341	1.175
48. Students seem to do the same type of activities every class.							
	2.55	1.184	2.39	0.979	1.705	.656	1.097
Individualization:							
7. All students in the class are expected to do the same work, in the same way and in the same time.							
	4.32	1.041	4.26	0.933	0.049	.860	0.993
14. Students are generally allowed to work at their own pace.							
	3.50	1.225	3.37	1.257	0.020	.736	1.240
21. Students have a say in how class time is spent.							
	3.59	1.182	2.89	1.286	0.559	.079	1.231
28. Students are allowed to choose activities and how they will work.							
	3.09	1.269	2.95	1.224	0.468	.715	1.248
35. Teaching approaches allow students to proceed at their own pace.							
	3.43	1.207	3.94	0.802	9.933	.131	1.041
42. There is little opportunity for a student to pursue his/her particular interest in this class.							
	2.41	1.182	2.11	0.832	4.545	.373	1.040
49. It is the instructor who decides what will be done in our class.							
	3.68	0.995	3.94	0.873	1.242	.386	0.942

Notes. The numbers prior to each item represent the numbered item in the instrument. *$p < 0.05$; **$p < .0.01$.

Appendix 3. Main effects of instructional method on each student grade item.

Scale	Traditional ($n = 22$)		Inverted ($n = 19$)		F	*p*	Cohen's *d*
	Mean	SD	Mean	SD			
Pop quizzes:							
#1	1.42	.142	1.42	.119	0.143	.989	0.132
#2	1.19	.231	1.21	.356	0.272	.852	0.295
#3	1.34	.323	1.42	.344	0.188	.447	0.333
#4	1.50	.000	1.42	.344	5.214	.288	0.233
#5	1.42	.179	1.33	.354	2.016	.293	0.274
#6	1.26	.440	1.32	.352	0.511	.668	0.402
#7	1.50	.000	1.42	.344	5.214	.288	0.234
#8	1.42	.119	1.32	.470	5.483	.319	0.331
#9	1.20	.126	1.37	.128	2.846	.000***	0.127
#10	1.50	.000	1.42	.344	5.214	.288	0.234
ASL literature:							
#1	4.16	1.070	4.31	1.061	0.583	.657	1.066
#2	4.49	1.049	3.31	2.039	17.760	.022*	1.585
#3	4.71	.327	4.24	1.509	6.455	.167	1.053
Deaf events:							
#1	4.39	1.023	4.15	1.024	0.480	.458	1.024
#2	4.46	1.010	3.82	1.386	1.594	.097	1.198
#3	3.74	1.817	4.29	1.066	6.626	.258	1.518
Exams:							
#1	8.30	.928	9.23	.343	17.225	.000***	0.720
#2	9.19	.479	8.78	.389	2.017	.005**	0.440
#3	9.57	.355	9.26	.734	19.821	.091	0.562
#4	7.69	.708	7.62	.760	0.484	.762	0.733
#5	13.57	.513	14.84	.314	1.943	.000***	0.433
Overall student grade score:							
	88.03	5.52	87.50	8.17	0.582	.808	6.872

Notes. *$p < 0.05$. **$p < .0.01$. ***$p < 0.001$.