Student perspectives on using Google Glass recordings to assess their communicative and clinical skills with standardized patients

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Abstract

Introduction: This exploratory study evaluated student perceptions of their ability to self and peer assess 1) interpersonal communication skills and 2) clinical procedures (a head and neck examination) during standardised patient (SP) interactions recorded by Google Glass compared to a static camera.

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Methods: Students compared the Google Glass and static camera recordings using an instrument consisting of 20 Likert-type items and four open and closed text items. The Likert-type items asked students to rate how effectively they could assess specific aspects of interpersonal communication and a head and neck exam in these two different types of recordings. The interpersonal communication items included verbal, paraverbal, and nonverbal subscales. The open text items asked students to report on more globally the differences between the two types of recordings. Descriptive and inferential statistical analyses were conducted for all survey items. An inductive thematic analysis was conducted to determine qualitative emergent themes from the open text questions.

Results: Students found the Glass videos more effective for assessing verbal [$t(22) = 2.091$, $p = .048$] and paraverbal communication skills [$t(22) = 3.304$, $p = .003$], while they reported that the static camera video was more effective for assessing nonverbal communication skills [$t(22) = -2.132$, $p = .044$]. Four principle themes emerged from the students open-text responses comparing Glass to static camera recordings for self and peer-assessment: (1) first person perspective, (2) assessment of nonverbal communication, (3) audiovisual experience, and (4) student operation of Glass.

Discussion and Conclusion: Our findings suggest that students perceive that Google Glass is a valuable tool for facilitating self and peer assessment of SP exams because of students' perceived ability to emphasise and illustrate communicative and clinical activities from a first-person perspective.

Introduction

Google Glass is a prototyped wearable, interactive, voice-controlled, technology that is equipped with an optical head-mounted display (Figure 1). It is part of an emerging information and communication technology sector commonly referred to as "smart glasses," which uses ambient intelligence, eye tap, smart grid, Bluetooth, and Wi-Fi technologies.[1-3] It was initially introduced to a limited number of invited users termed, "Google Explorers," in April, 2013. While sales of Google Glass were discontinued in

January 2015, Google is reportedly committed to continuing with development of this technology, with a possible strengthening of its emphasis on medical, educational and industrial applications. Additionally, a number of other corporations such as Sony, Microsoft, ODG and others have now taken the lead in the smart glasses arena.

Various applications for Google Glass have been noted in higher education literature.[4] In the dental and medical education communities, Google Glass has been applied to remote mentoring, distance learning, live streaming of clinical procedures, simulation-based training, virtual student-faculty communication on the clinic floor and video debriefing sessions.[5-12]

The Indiana University School of Dentistry (IUSD) had been using Google Glass in Objective Structured Clinical Examinations (OSCE) so as to evaluate the value of smart glasses' educational functionality and utility in recording interactions between students and standardised patients (SP). These Glass recorded encounters were then reviewed by small groups of students during Behavioural Patient Management Rounds. The video review process allowed faculty to debrief with students about the simulated clinical interviews and for students to further engage in critical self and peer assessment. For developing dental clinicians, this type of reflective debriefing and assessment can be an effective approach to clinical communication skills training.[13]

Self- and peer-assessment is an integral part of professional school training as it promotes the attainment of the skills necessary for lifelong learning and self-regulation.[14,15] These processes are grounded in the theories of social constructivism, active learning, andragogy, metacognition, and self-efficacy, whereby adult students are responsible for making critical judgements about their own achievements and the achievements of their peer colleagues.[15-19] Video-based self and peer assessment of OSCEs is a method that has demonstrated positive educational outcomes in the professional school setting.[20-22]

For the past several decades, student- SP interactions in OSCEs have nearly always been recorded using 1 or possibly 2 static cameras. Eventually, technologies were developed to allow a third party outside of the exam room or operatory to potentially maneuver the camera during the recorded encounter. However, not until recently, has the technology been available to allow developing dental providers the ability to physically control the recording process. This self-controlled videography affords the learner the ability to later review a unique perspective of their clinical activities (e.g. head and neck examination) and their communicative engagement with patients otherwise not possible with static cameras.[5-8]

The use of Glass in OSCEs introduces an egocentric vision paradigm into the self and peer assessment processes. Egocentric vision is a first-person perspective of the human experience recorded by a wearable device that is inherently human-centric, or in the case of the present study, inherently student-centric.[23,24] Two advantages of the egocentric vision paradigm guided the rationale to explore shifting from a static third-person perspective to a dynamic egocentric perspective: 1) objects of interest tend to be centred, large-scaled, and unobstructed, and 2) activities of interest typically consist of the user manipulating objects in their field of vision.[28] The shift to a student-centred egocentric recording process supports active learning principles[18,25-27] in that it gives dental students more control over and responsibility for their own learning, and engages them with a dynamic unobstructed perceptual perspective that foregrounds objects and activities of interest.

To our knowledge, there are no other studies comparing OSCE recordings of static cameras to egocentric smart glasses for the purposes of self and peer assessment. Therefore, the purpose of this exploratory study was to evaluate student perceptions of how standardised patient interactions recorded by egocentric smart glasses compare to those recorded by a static camera. Specifically, this study addressed the following research questions: (1) How do students perceive Google Glass compared to static camera videos for the purposes of conducting self and peer assessments of interpersonal communication skills with standardised patients? (2) How do students perceive Google Glass compared to static camera videos for the purposes of conducting self and peer assessments of head and neck examinations with standardised patients?

Methods

Institutional Review Board

This study (IU IRB # 1409196999) was determined by the Human Subjects Office, Office of Research Compliance, Indiana University, to be IRB exempt under 45 C.F.R. § 46.101 (b), paragraph(s) (1) and (2).

Study design

A subgroup of third year students assigned to participate in an OSCE self-selected to record their SP station using Google Glass recording devises. Specifically, volunteers used one of two fully charged Google Glass units equipped with polycarbonate shields. These units worn by the students ran version XE22 software to record the standardised patient encounter while another more traditional single ceiling mounted static camera also captured the same interaction.

All recorded SP OSCE sessions, using static camera video or Google Glass, were subsequently reviewed during Behavioural Patient Management small group discussion sessions, facilitated by the authors. During sessions in which SP stations were recorded by both Glass and a static camera, students completed a Video Review Assessment Effectiveness Scale (VRAES) instrument for each type of video. The VRAES asked students to rate how effective each type of video was for assessing verbal, nonverbal, and paraverbal communication skills, and a head and neck clinical examination.

Video Review Assessment Effectiveness Scale (VRAES)

Students who reviewed a Google Glass recording during their Behavioural Patient Management small group discussion sessions completed the twenty-four (24) item VRAES instrument. The instrument consisted of four (4) open and closed text items and twenty (20) Likert-type items with a response set ranging from "Very Easily Assessed" (5) to "Very Difficult to Assess" (1). The Likert-type items asked students to rate how easily they could assess specific aspects of interpersonal communication and a head and neck clinical examination in the Google Glass versus fixed camera recordings. The interpersonal communication items included verbal, paraverbal, and nonverbal subscales. The open text items asked students to discuss more globally their perceptions of the differences between the two types of recordings.

The communication items of the VRAES were modified from Makoul's SEGUE Framework, a validated instrument for measuring communication competency.[28] A modified SEGUE Framework was used by the SPs to assess students' interpersonal communication skills, and by the students for self- and peer-assessment. Makoul's modified items were categorised by the study investigators into verbal, nonverbal, and paraverbal subscales. For the purposes of categorisation, verbal communication was defined as the content of the message including the selection of words, while nonverbal communication was defined as body language such as posture, gesture, facial expression and spatial distance. Paraverbal items included those related to how we communicate a message, such as tone, pitch pacing and volume of the voice. The head and neck exam subscale was developed and reviewed by faculty in the Department of Oral Pathology, Medicine and Radiology at the IU School of Dentistry, and was based on the instruction students receive for conducting the procedure.

Analysis

Cronbach's Alpha was calculated for the VRAES instrument. An α of .854 for the overall instrument indicates a very good average correlation of items within the survey. Additionally, a Cronbach's Alpha was calculated for each of the instrument's 5 subscales: (1) Combined Interpersonal Communication Subscale (verbal, paraverbal, and nonverbal subscales), $\alpha = .855$; (2) Verbal Communication Subscale, $\alpha = .852$; (3) Paraverbal Communication Subscale, $\alpha = .957$; (4) Nonverbal Communication Subscale, $\alpha = .769$; and (5) Head and Neck Exam Subscale, $\alpha = .948$. The high α values suggest the scale(s) are reliable and the items are closely related and measuring the same constructs.

A descriptive statistical analysis was conducted on the Likert-type items and the open text items were analysed using a thematic inductive qualitative analysis. The entire Likert scale and all subscales were treated as interval level indexes. The sum score for the items range from 100 (very effective) to 20 (very ineffective) and each subscale ranges from 25 (very effective) to 5 (very ineffective). The sum scores for all of the indexes were analysed using a dependent t-test (95% CI) in order to determine statistically significant differences in mean scores.

Results

Of the 112 second-year DDS students who were eligible to participate in this study, seven (7) volunteered to record the standardised patient station of their OSCE using Google Glass. Twenty-three (23) students reviewed Google Glass and static camera video recordings of one of the seven volunteers during their Behavioural Patient Management small group discussion sessions. All 23 students rated the effectiveness of each type of video for the purposes of self and peer assessment using the VRAES instrument (Table 1). In addition to completing the VRAES instrument for each video type, all 23 students responded to 4 open and closed text items about using Google Glass and static video for self and peer assessment.

Overall (Table 2), there was not a statistically significant difference between mean scores of the Glass and static camera videos on the VRAES, $t(22) = 1.702$, $p = .103$, although the Glass recordings ($\bar{x}$=84.61) had a higher mean score than the static camera ($\bar{x}$=79.74).

Verbal Communication

Students reported that verbal communication was more easily assessed by reviewing the Glass video ($\bar{x}$ =23.87) compared to the static camera recording ($\bar{x}$=22.17). This finding is statistically significant at a 95% confidence interval, t(22) = 2.091, p = .048 (Table 2). Students rated the Glass video higher for every item on the verbal communication subscale (Table 1). In particular, their ability to assess "explanations to the patient" produced the largest difference between the Glass (100%) and static camera (82.6%) videos, while "interruptions of the patient" had the smallest difference between the Glass (86.9%) and static (82.6%) recordings.

Paraverbal Communication

Students reported that paraverbal communication was more easily assessed by reviewing the Glass ($\bar{x}$=24.26) video compared to the static ($\bar{x}$=21.51) camera recording. Similar to the verbal communication subscale, this finding is statistically significant at a 95% confidence interval, t(22) = 3.304, p = .003 (Table 2). Every item on the paraverbal subscale except for "voice inflection" (95.7%) was rated by every student (100%) as either easily or very easily assessed by reviewing the Glass video (Table 1). The largest difference between the Glass (100%) and static (69.5%) ratings was with regard to the "voice volume" of the operator.

Nonverbal Communication

There was a statistically significant difference in mean scores between the Glass and static camera videos on the nonverbal communication subscale, t(22) = -2.132, p = .044. Students reported that it was more effective to assess nonverbal communication by reviewing the static camera ($\bar{x}$=19.78) video compared to the Glass video ($\bar{x}$=17.09). A higher percentage of students (Table 1) rated the static camera video as more effective for self/peer assessment of nonverbal communication on every item on the subscale except for "Eye contact with the patient" (Glass: 60.9%; Static: 47.8%).

Emergent Themes

Student comment about the Glass and static camera recordings were focused in four thematic areas (Table 3): First-person perspective (Egocentric vision), assessment of nonverbal communication, audiovisual experience, and student operation of Glass. Two sub-themes emerged under the first-person perspective theme, relative to reactions of the patient and attention/eye-contact of the student. Additional sub-themes of viewing area and audiovisual quality also emerged under the audiovisual experience theme and sub-themes of head movements and camera line of site/position of the camera emerged under the student operation of Glass theme. The emergent qualitative themes and sub-themes will be used to guide the discussion in the next section.

Discussion

First-person perspective (Egocentric vision)

Similarly to Paro et al,[3] students reported an appreciation for being able to assess dental student-patient interactions from the first-person perspective gained through using Google Glass video.

> *"First person vs. third person [perspective] allows you to understand a little more from the perspective of the wearer. You could also look back and see patient reactions to what was said."*
>
> *"By seeing the student's perspective, it gives you an idea of what you should be looking for. It also captures little things like head placement when talking to the patient."*

Their own labelling of a perceptional shift from a static third-person to Glass observations as first-person seemed to be an indicator for them of how Google Glass foregrounds images and sounds, which is consistent with the egocentric vision paradigm.

Additionally, student reviewers perceived this perspective as a more engaging and authentic experience.

> *“It allowed me to feel more engaged in the assessment portion of this experience.”*

In turn, this may have further contributed to their perception that they could more easily assess verbal and paraverbal skills as suggested by the analysis of the student responses on the VRAES.

Reactions of the patient

Glass and static videos recorded the same content of the messages being communicated between the student and the SP. However, with Glass video, the students’ perceived engagement with observing the interaction from an egocentric perspective may have contributed to their reported perception that they felt as though they could more effectively assess verbal skills with the Glass video because, as the evaluator, they were able to directly see the patient’s reaction to what is being discussed.

> *“With the stationary recording, it was more difficult to see the attitudes and the reaction of the patient.”*

These nonverbal ques of the patient, captured in the first-person, likely informed the students as to how well their verbal message – e.g. greeting, use of jargon, explanations, interruptions, use of open and closed questions – was being conveyed to the patient.

Attention/eye-contact

In addition to the egocentric perspective being facilitative of seeing the reactions of the patient, the students also reported that they could better determine where their attention was during the exam and how well they were maintaining eye contact with the patient.

> *"Google Glass greatly enhanced this educational experience because it allowed me to assess where my attention was directed during the simulated patient encounter."*
>
> *"Eye contact can be determined with Google Glass, but not necessarily with the stationary camera."*

This is consistent with others[5] who have reported that the egocentric perspective of Glass allows students to identify what and where they were focusing on during the clinical encounter.

Assessment of nonverbal communication

A disadvantage to assessing egocentric video is that much of the operator's nonverbal communication is not captured. This was reflected in the students' reporting on the VRAES and in their written responses that the static camera video was more effective for assessing nonverbal communication:

> *"I prefer a stationary recording so that I can see body language of both people."*

Most of the nonverbal communication skills students were asked to assess were unobservable in the Glass videos. In all but 1 Likert-type item on the nonverbal subscale ("Eye contact with the patient"), students reported that the static camera was more effective for assessing nonverbal communication skills.

A possible solution for assessing nonverbal communication of the operator in egocentric video is to setup a bi-directional egocentric recording process, whereby the students and SPs both wear smart glasses, simultaneously becoming both operator and object. Tully has reported that when the patient wears the Glass, the video provides a "unique perspective for the analysis and evaluation of [students'] interpersonal communication skills and nonverbal behaviours".[2] Another possibility is to supplement the egocentric smart glasses with a static camera recording. Both setups would produce two videos that could be synced and reviewed by the students.

Audiovisual experience

Viewing area

Another limitation of the egocentric video produced by Google Glass was the limited viewing area of the recording. Students reported in the open and closed-text questions that the viewing area did not capture as much information as the static camera:

> *"I feel like you lose a lot of pt/student interaction information with these glasses."*

Objects and actions of interest are much larger in egocentric video, and often take up most of the viewing area of the recording. Although students reported that they engaged with the first-person perspective and perceived that they could better assess their verbal and paraverbal skills, some students felt as if critical background information wasn't visible. Similar to the solution for assessing nonverbal communication of the operator, a static camera recording could supplement the egocentric video, which would be able to capture some of the background information that the students reported missing.

Audiovisual quality

Students reported that the video quality of the Glass recordings was *"clearer and sharper"* than that of the static camera. Additionally, the video quality and the first-person perspective were facilitative of self/peer assessment of the intraoral exam:

> *"[Video of] the intraoral was exceptional, which differs greatly from the traditional method."*

This is consistent with the egocentric video paradigm in that the objects of interest, e.g. hard and soft tissues, hands, instrumentation, and the activity, e.g. conducting an exam, were centered in the foreground and large-scaled. This also supports students reporting that skills such as, examining the oral cavity with a mirror and examining posterior lateral borders, were easier to assess with the Glass recording than the static camera (Table 1).

Students also reported that they preferred the audio quality of the Glass recordings, suggesting that

> *"The Google Glass obtained a better audio and a more close-up experience that was easier to see every aspect of what went on throughout the interaction."*

Students' perceptions that a paraverbal skills such as voice volume, tone of voice, clarity of voice, pacing of questions, and voice inflection are more effectively assessed by observing a Glass video is likely linked to their preference for the egocentric audio, because the hardware centres and amplifies the operator's voice. It is notable, however, that as was reported qualitatively in this and in other studies,[2] there is good audio quality for the Glass wearer, but it can be difficult to hear the voice of the patient or another person. Thereby, students may feel that paraverbal clinical communication is more importantly captured by the centring and amplifying of their own voices rather than the effective capturing of the patient's voice.

Student operation of glass

Head movements

Although students perceived that Glass had enhanced audiovisual capabilities, they also reported some challenges in using the hardware. Videos with sudden or rapid head movements were difficult for some students to review because there was:

> *"…too much movement in recording causing disorientation and even slight headaches."*

This was often the case when students were conducting the intraoral and extraoral exam of their patient, where a student may make a sudden head movement to locate and instrument or as the maneuver around the patient during the exam.

Camera line of site/position of camera

Additionally, students reported that the Glass video didn't always capture what was intended:

> *"Because the Glass follows head position and not eye position, the camera did not always capture where I was looking effectively."*

With the Glass hardware, the camera is offset to the right of the operator, so during a procedure, if the operator does not check the optical head-mounted display, there is a chance that what is captured on video is not what the operator intended because the camera does not align with the operator's line of site.

These factors were likely related to the findings on the Head and Neck Examination subscale, where, although students rated every item as more effectively assessed by a Glass video, the differences between the two recording methods were not significant. In some recordings, the objects and activities were captured in high quality video and were large-scaled and centered in the viewing area, facilitating more effective self and peer assessment, but in others, sudden head movements and partial recording of the objects and activities of interest detracted from the self and peer assessment process.

Conclusion

Our findings suggest that students perceived that egocentric video recorded by smart glasses was a valuable tool for facilitating self and peer assessment of SP stations in OSCEs because of their perceived ability to emphasise and illustrate communicative and clinical activities from a first-person perspective. Depending on the desired educational outcomes, smart glasses may be a helpful adjunctive teaching technology to use during these types of student assessments. Further evaluation is needed of egocentric video for use in standardised and real patient encounters for purposes of assessing clinical procedures such as conducting of a head and neck examination, in particular, addressing the concerns about sudden head movements and the camera not aligning with the operator's line of site.

We recommend conducting training sessions with students prior to using the Google Glass, or other next generation smart glasses, in order to discuss the relationship between the camera position and the operator's line of sight. Additionally, if the primary educational outcome of the SP station is assessment of a clinical procedure, it is recommended to have students wear the smart glasses, and to supplement the recording with a static camera to capture the communicative skills egocentric video is unable to capture. Finally, if the primary educational outcome is assessment of interpersonal communication skills, it is recommended, as suggested by Tully,[2] for the SP or both parties to wear the smart glasses in order to capture the student's nonverbal behaviours.

A limitation of this exploratory study is the small sample size, with 23 out of 112 students comparing Glass and static camera recordings. Because of this, the quantitative results of this single study may not be generalizable. Additional limitations include lack of previous instrument validation and lack of student training on using Google Glass.

The influence of the novelty of using new technology on student perceptions of the ability to self and peer assess was not tested in this student and is a recommended area for further research. Another areas for future research is to compare student assessments to expert preceptor assessments to provide a more objective or hard measure of the assessment. Lastly, the feasibility of incorporating smart glasses into the dental education curriculum needs to be evaluated, relative to using more traditional static cameras.

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Table 1. Student ratings of self/peer assessment using Google Glass vs. static camera videos

Communicative and Clinical Skills	Sum % (easily or very easily assessed reported)	
	Google Glass	*Static Camera*
Verbal: Use of jargon with the patient	100%	87%
Verbal: Greeting the patient	91.3%	86.9%
Verbal: Explanations to the patient	100%	82.6%
Verbal: Interruptions of the patient	86.9%	82.6%
Verbal: Use of open and closed ended questions	100%	86.9%
Paraverbal: Tone of voice	100%	82.6%
Paraverbal: Volume of voice	100%	69.5%
Paraverbal: Clarity of voice	100%	82.6%
Paraverbal: Pacing of questions	100%	82.6%
Paraverbal: Voice inflection (demonstration of interest)	95.7%	78.3%
Nonverbal: Eye contact with the patient	60.9%	47.8%
Nonverbal: Body posture and proximity to the patient	47.8%	82.6%
Nonverbal: Facial expressions of the student	30.4%	60.9%
Nonverbal: Attentiveness (head nods/posture) of the student	60.8%	82.6%
Nonverbal: Using gestures appropriately	44.5%	86.9%
Head & Neck Exam: Using the mouth mirror to exam the oral cavity	65.2%	43.5%
Head & Neck Exam: Examination of posterior lateral borders by reflecting patient's tongue to the right and left using gauze	73.9%	39.1%
Head & Neck Exam: Using the mouth mirror to depress the tongue and ask the patient to say "ahh"	69.6%	39.1%
Head & Neck Exam: Bimanual palpation of the floor of the mouth	73.9%	43.4%
Head & Neck Exam: Palpation of the anterior and lateral neck standing behind the patient	65.2%	60.9%

Table 2. Comparison of Mean Ratings between Google Glass and Static Camera Videos

Scale/subscale	Google Glass Mean	Static Camera Mean	Dependent t-test
Video Review for Self/Peer assessment Effectiveness Scale	84.61	79.74	$t(22) = 1.702, p = .103$
Verbal Comm Subscale	23.87	22.17	$t(22) = 2.091, p = .048$
Paraverbal Comm Subscale	24.26	21.57	$t(22) = 3.304, p = .003$
Nonverbal Comm Subscale	17.09	19.78	$t(22) = -2.132, p = .044$
Head and Neck Exam Subscale	19.39	16.22	$t(22) = 1.854, p = .077$

Table 3. Emergent Qualitative Themes Influencing Student Perceptions of Glass vs. Static Camera Video for Self and Peer Assessment

Themes	Sub-themes
First-person Perspective (Egocentric Vision)	Reactions of the patient Attention/eye-contact of the student
Assessment of Nonverbal Communication	
Audiovisual Experience	Viewing area Audiovisual quality
Student Operation of Glass	Head movements Camera line of site/position of camera