

# Interactive pedagogic tools: evaluation of three assessment systems in medical education

## *Outils pédagogiques interactifs: évaluation de trois systèmes pour la formation médicale*

Guillaume Grzych<sup>1,2,3</sup>

Susanna Schraen-Maschke<sup>4,5,6</sup>

<sup>1</sup> Université de Lille, Faculté de pharmacie, Lille, France

<sup>2</sup> CHU Lille, Service d'hormonologie, métabolisme, nutrition, oncologie, Lille, France

<sup>3</sup> Université de Lille, Inserm, Institut Pasteur de Lille, U1011- EGID, Lille, France

<sup>4</sup> Université de Lille, Faculté de médecine, Lille, France

<sup>5</sup> CHU Lille, Service de biochimie automatisée Protéines, Lille, France

<sup>6</sup> Université de Lille, Inserm, JParc, UMR S-1172, Lille, France

**Abstract.** Training in biology, pharmacy and medicine are essential in laboratory medicine in faculty and especially with recent residency modifications. Active learning improves critical thinking and is an essential component of health education. Interactive assessment systems for the interactive participation of students have emerged. Recently, many offers of audience response system (ARS) accessible by personal electronic devices such as smartphone, tablet or computer are available. These systems seem to be an effective teaching innovation according to students. We aimed to evaluate three pedagogical tools during real school lectures in order to be able to select them according to the needs: Votar, Socrative and Wooclap. **Methods:** Three connected participation tools will be tested during teaching at Lille University, faculty of pharmacy by 3 different teachers. 75 fifth-year pharmacy students divided into 2 groups of students will have attended at least one session using each of the systems studied. After lessons, an online questionnaire with 9 questions was submitted to students on their interest in each system. Questions measured student perception using a 1 to 10 scale. **Results and discussion:** 62 of 75 students completed online surveys and were included in the study. According students, ARS by smartphone or computer improve their education. Favorite application seems to be Socrative and Wooclap. This study provides student perception comparison of ARS. To complete, additional studies are needed to establish their efficacy after several month.

**Key words:** active learning, interactive pedagogy, audience response system, student perception, online tools

**Résumé.** La formation en biologie médicale des étudiants de pharmacie et de médecine est essentielle dans leur cursus, spécialement depuis la dernière réforme du DES. L'apprentissage actif améliore l'esprit critique et est un élément primordial dans les études de santé. Dans ce but, les systèmes interactifs en enseignement ont émergé récemment. De nombreuses offres de système de réponse d'audience sont maintenant disponibles, permettant de poser directement une question à un auditoire grâce à un appareil personnel tel que smartphone, tablette ou ordinateur. Nous avons évalué trois de ces outils pendant des enseignements afin de sélectionner celui le plus en accord avec nos besoins : Votar, Socrative et Wooclap. **Méthodes :** Trois outils de participation connectés ont été testés pendant des conférences de préparation au concours de l'internat à la faculté de pharmacie de Lille, ces séances interactives ont été réalisées par 3 conférenciers différents. 75 étudiants de 5<sup>e</sup> année de pharmacie divisés en 2 groupes ont participé à au moins une séance utilisant un outil de participation connecté. Après les cours, un questionnaire en ligne avec 9 questions a été soumis à l'ensemble des étudiants portant sur leur appréciation

Article received May 11, 2019,  
accepted June 21, 2019

**Correspondence :** G. Grzych  
<guillaume.grzych@inserm.fr>

générale de chaque outil. Chaque question a été évaluée sur une échelle de 1 à 10. *Résultats et discussion* : 62 étudiants sur 75 ont complété le questionnaire de façon suffisante pour être inclus dans l'étude. Selon les étudiants, ces systèmes connectés améliorent leur formation. Les applications favorites semblent être Socrative et Votar. Cette étude fournit la perception globale des étudiants vis-à-vis de ces outils. Pour la compléter, des études supplémentaires sont nécessaires afin d'évaluer la performance à long terme.

**Mots clés** : apprentissage actif, pédagogie interactive, système de réponse d'audience, perception des étudiants, outils en ligne

Training in biology, pharmacy and medicine are essential in laboratory medicine in faculty and especially with recent residency improvements [1]. In this study, we aimed to evaluate new methods to improve training in medical education. Active learning improves critical thinking and is an essential component of health education [2, 3]. This active teaching method stimulates the students' interest and allows the direct application of the educational content compared to the traditional lectures without participation tools, which lead to a more passive listening and learning environment [4]. Moreover, in traditional teachings, the interaction of the teacher with his audience is quite difficult, especially with a large number of students. Interactive assessment systems for the interactive participation of students have emerged [5, 6]. They allow during a lesson to ask a direct question at the assembly and immediately extract and analyze the results. The use of connected systems like audience response system (ARS) showed that students felt more involved in the course through the use of these tools [7]. So, involvement of student leads to a better understanding and learning.

Some systems use connected voting boxes; however, their use requires a significant initial investment and requires a certain amount of logistics when put into practice. Indeed, this system is limited by the number of boxes available, which consequently limits the number of students or the number of interactive sessions that can be performed simultaneously. Recently, many offers of ARS accessible by personal electronic devices such as smartphone, tablet or computer are available. These interactive pedagogic tools are accessing directly through the web and use systems that require less hardware and less logistical support. These systems seems to be an effective teaching innovation according to students [6] (*table 1*).

Votar (*vote with augmented reality*) is an augmented reality voting system. Audience keeps printed sheets with a specific symbol (square with 4 colors) and teacher takes a picture on smartphone with application, which will analyze and count the votes (*figure 1A,B*). This system was developed by a personal initiative (<https://votar.libre-innovation.org/>). The project source code is distributed under free license.

Socrative system (MasteryConnect, Salt Lake City, USA) is a participative tool directly usable on a web interface or smartphone application by teacher and student [8] (*figure 1C*). Student can answer to question by a smartphone interface by simply checking to the right answer (*figure 1D*). License is free until 50 students and one classroom and paid for more students (*table 1*).

Wooclap (Wooclap SA, Brussels, Belgium) is a participative tool directly usable on a web interface or with phone messages. Students can answer to question activity or answer directly to question during class through message server (*figure 1E*). Teacher, through a specific interface, creates different activities such multiple response choice, polls, open question matching or many others (*figure 1F*). Student can also inform in live if he is lost during class through a thumbnail (*figure 1E*) that appeared directly on presentation slide that inform teacher who can slow down (*figure 1G*). Moreover, teachers can use directly their traditional presentation slides (power point, google slides or PDF) into online tools to add activity directly into their files. License is free until 30 students and paid for more students (*table 1*).

We aimed to evaluate these interactive pedagogic tools (IPT) by student perception during real school lectures in order to be able to select them according to the needs.

## Methods

### Participants

Three connected participation tools are tested in teaching at Lille University, faculty of pharmacy. 75 fifth-year pharmacy students divided into 2 groups of students have attended at least two sessions using each of the IPT studied to limit novelty effect. 62 on 75 students participated on online survey. The different classes involved are be taken by all participants students.

### Studies tools

Three IPT are tested, Votar, Socrative and Wooclap, compared with traditional lesson. Traditional is defined by a

**Table 1.** Description of interactive pedagogic tools tested.

Tools	URL Link	Smartphone application		Integration into slide presentation	Students able to ask questions through the tool		License
		For student	For teacher		Any time	At specific moment	
Votar	<a href="https://votar.libre-innovation.org/">https://votar.libre-innovation.org/</a>	No	Yes	No	No	No	Free
Socrative	<a href="https://www.socrative.com/">https://www.socrative.com/</a>	Yes	Yes	No	No	Yes	Free until 50 students or paid license
Wooclap	<a href="https://www.wooclap.com/">https://www.wooclap.com/</a>	No	No	Yes	Yes	Yes	Free until 30 students or paid license

classic school lecture without use of any ARS, daily use in our faculty of pharmacy.

### Survey

Several days, after lessons sessions ended, a global online questionnaire with 9 questions was submitted to students on their interest in each system. Questions measured student perception using a 1 to 10 scale (*table 2*). This online questionnaire was made with Google Forms tools (Menlo Park, California, USA) and sent at students by social network Facebook (Menlo Park, California, USA). Survey is divided in 3 parts: pedagogic aspect with ARS comparison including traditional lesson (question 1 to 6), technical aspect for ARS only (question 7 and 8) and global (question 9).

### Statistical analyses

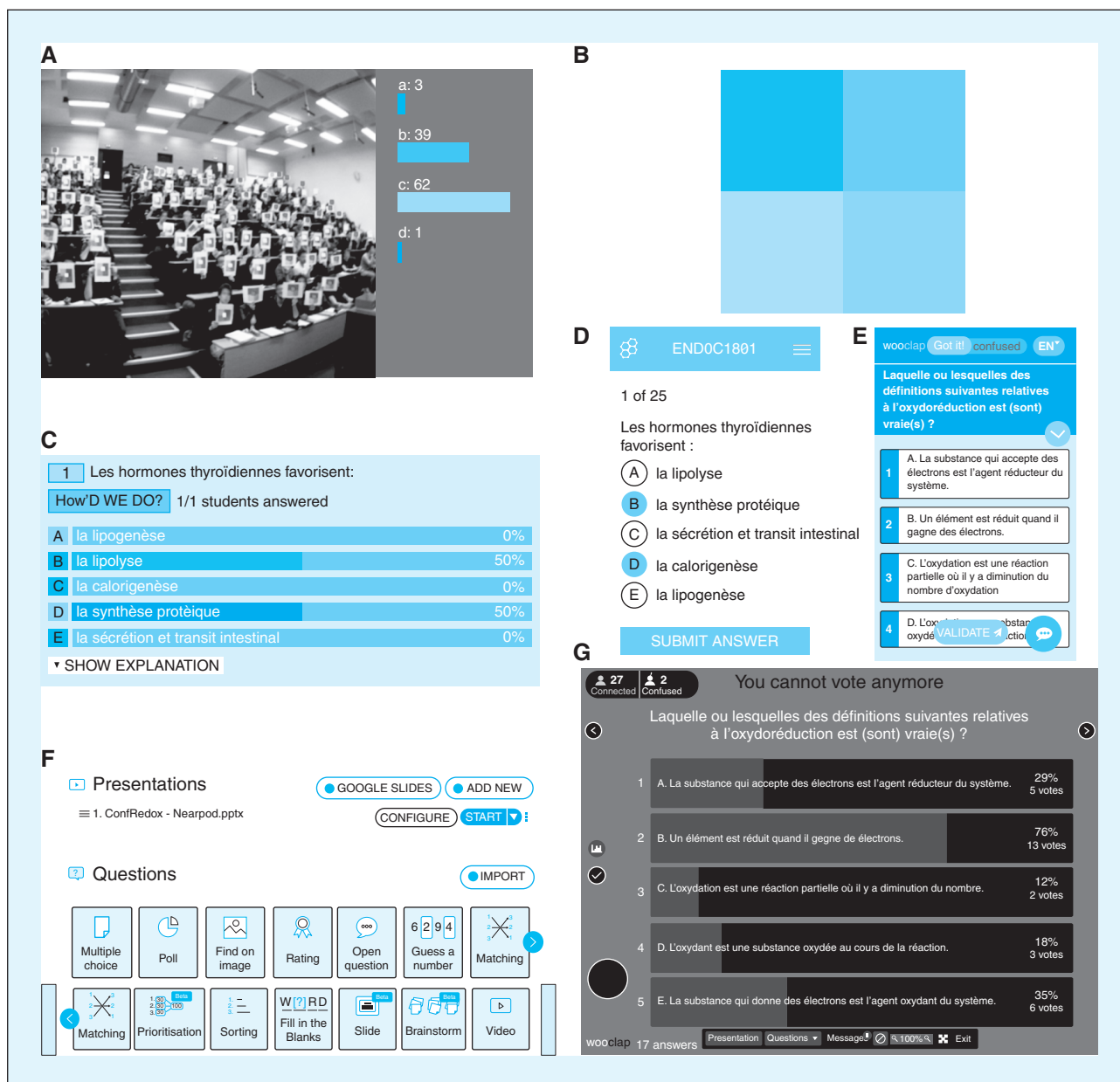
Data analyses were performed using R software ([www.R-project.com](http://www.R-project.com)) and GraphPad Prism Software v.6, t-tests, one Way Anova and Tukey test were performed. Statistical significance was defined as p-value <0.05.

## Results

66 of 75 students completed online surveys (88% survey response rate). Four surveys were excluded from the analysis due to outlier results (i.e. same rate for all questions). For each of 9 questions, student give rate for each study tools except for question 7 to 9 where traditional lesson was excluded. Survey results was shown in *figure 2* and analyzed by Tukey's multiple comparisons test.

Overall, higher mean scores are reported for ARS (Wooclap, Socrative and Votar) compared to traditional ( $p < 0.05$ ) except for question 1,3 and 5 for Votar system compared to traditional. Students reported higher mean scoring preference for Socrative and Wooclap applications compared to traditional and Votar system for question 1, 2 and 3 ( $p < 0.05$ ) and compared to Votar only for question 7, 8 and 9: learning, understanding, participation during class, ease, integration of tools and global rate.

The only significant difference between Wooclap and Socrative was found for question 4 about asking and answering question during lesson ( $p < 0.05$ ) and no significant difference with ARS compared to traditional lesson. For question 6, only Wooclap have a higher score compared to Votar and Traditional ( $p < 0.01$ ), question about possibility to insist on the essential notions during lessons.



**Figure 1.** (A) Using Votar system during class and results analysis (picture source: <http://votar.libre-innovation.org>). (B) Votar answer sheets with 4 different colors. (C) Screen shot of Socrative slide with multiple response choice of students. (D) Socrative student smartphone interface. (E) Wooclap student interface with multiple choice question items, message and confused thumbnails. (F) Wooclap teacher interface with different types of activity. (G) Screen shot of a Wooclap slide with different icons, stopwatch, number of students connected and confused students in live, number of answers to activity, results of number of multiple response choice and students received live messages directly read by teacher interface.

## Discussion

Importance of training in biology is rising. New pedagogic tools could help us to improve our educational method. Numerous new methods in medical education limit interaction between student and teacher as on-line lesson or video

lesson. Interaction between student and teacher in medical education remains important and essential. So, some new technology permits to improve education and keeps this interaction. We assessed the student perception of these new methods. Our survey shows that overall ARS systems are appreciated by students and help them to understand

**Table 2.** Student survey and meaning of different scale used.

Question		0	10
<b>Pedagogic aspect</b>			
Question 1	Evaluate help to memorize during classroom	Not helpful to memorize	Very helpful to memorize
Question 2	Evaluate your active participation during classroom	I did not participate	I participated a lot
Question 3	Evaluate the understanding during classroom	Does not improve understanding	Improve totally understanding
Question 4	Does the format allow you to ask and answer to some questions during the session?	Not agree	Totally agree
Question 5	Does this tool encourage you to attend the course	Not agree	Totally agree
Question 6	The format makes it possible to point essential notions to the lessons?	Not helpful	Very helpful
<b>Technical aspect</b>			
Question 7	Evaluate the ease of use of the tools	Not easy at all to use	Very easy to use
Question 8	Evaluate the integration of tools on classroom	No integration	Complete integration
<b>Global</b>			
Question 9	In general, note the tool on a scale of 1 to 10	Bad	Good

and learn. Moreover, students easily use IPT since first use.

One of the biases of our investigation is the potential novelty effect, so we cannot guarantee that in the long term there is not an effect of weariness of IPT on the students. It will be interesting to test participation few months after their introduction. At the same time, we collected feedback from the lessons on the tools used. However, we did not have enough different teachers to perform a statistical comparative study about teacher perception of our IPT.

Learning, understanding, participation during class, ease and integration of tools are higher for Wooclap and Socrative compared to Votar and traditional lesson with no significant difference between these 2 tools. Only significant difference between Wooclap and Socrative was about asking and answering question during lesson ( $p < 0.05$ ). Indeed, Wooclap allow student to ask directly question through website or application and teacher could answer directly or not. However, none of the tools seem to make it easy for students to ask questions compare to traditional lesson. The presence of a teacher is therefore always appreciated and seems important for students.

Votar system may also be subject to errors related to taking pictures and recognizing the colors of the squares. Use can also be difficult in some types of rooms that do not have a vertical drop. Votar do not show better results for learning, understanding and attending lesson. We hypothesized that is because students do not use computer or smartphone device, they are less active with Votar compared to other system.

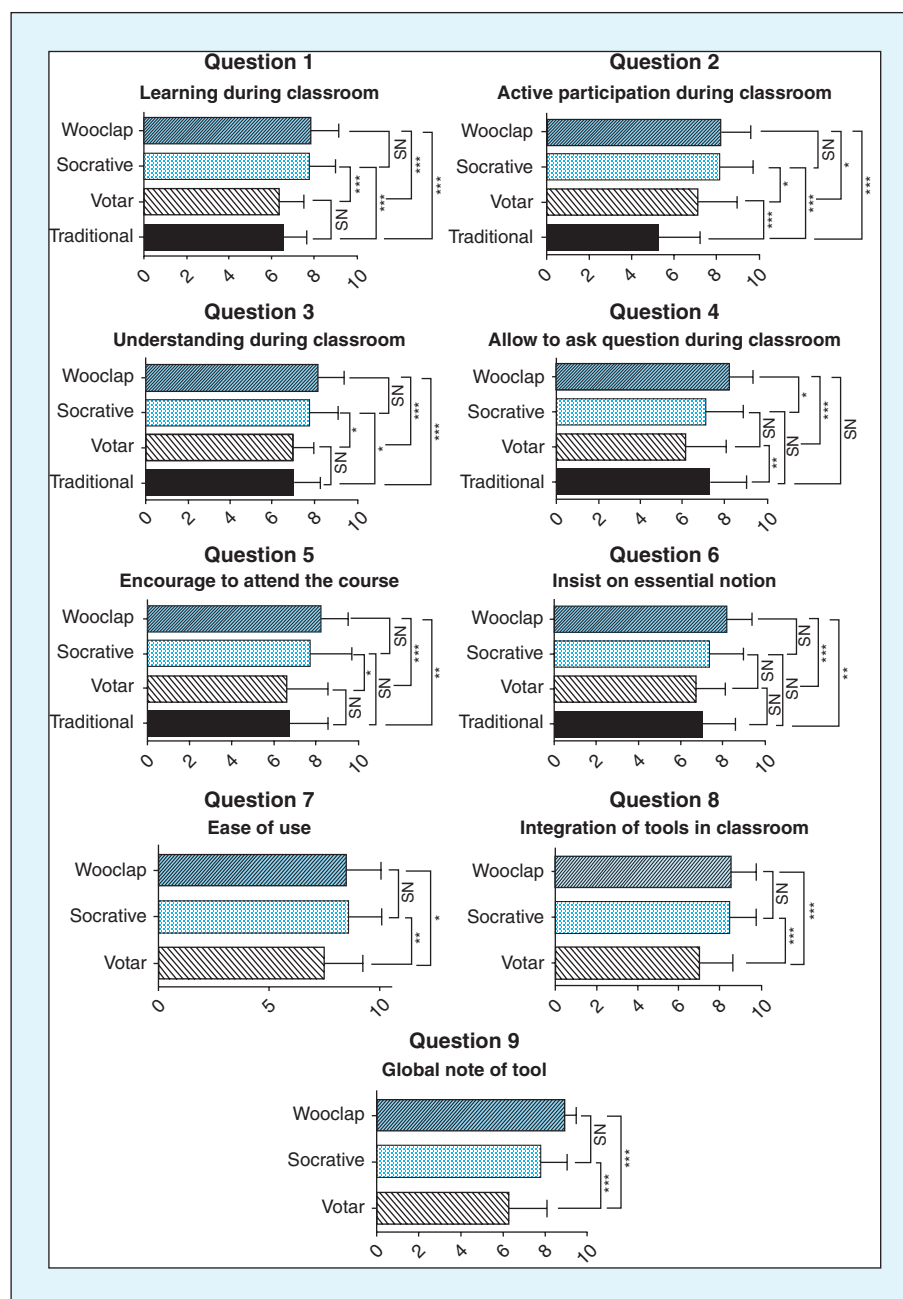
Money wise, Wooclap app is the most expensive and is very limited in its free use (only 30 students per session). Free license software Votar seems to be the most interesting if we do not want to use a complete system and ask only a few simple questions during a lesson. One of the important advantages of Votar is that its use requires very few materials. Answer sheets can be directly printed in color and used during class.

Wooclap is a very complete solution that offers many varied activities, however it is necessary to use these activities sparingly. Indeed, we observe that after a while, fewer students answer the question as the class time progresses.

To complete, additional studies are needed to establish its efficacy after several month, during exam for example to complete the work of Stoddard published in 2010 [9]. Indeed since Stoddard work, ARS have evolved and are more easy to use for student and offer various activity systems. We evaluated these tools on pharmacy student but we think these tools could be also used with other medical students as biology residents as in case of problem-solved learning [10].

## Conclusion

According students, ARS by smartphone or computer improve their education. Favorite application seems to be Socrative and Wooclap. This study provides student perception of these ARS. To complete, additional studies are needed to establish its efficacy after several month.



**Figure 2.** Survey results of 9 themes from 62 students, obtained mean on 1 to 10 scale for each tools. Exact title of question are provided in table 2. p-value are obtained by Tukey's multiple comparisons test, errors bars represents standard deviation of each results. NS: non significant. \*p-value <0.05, \*\*p-value <0.01, \*\*\*p-value <0.001.

**Conflict of interest:** none of the authors has any conflict of interest to disclose.

## References

1. Cassinari K, Grunewald O, Snanoudj-Verber S, Moulis M, Rollier P, Barrand L, *et al.* Le diplôme d'études spécialisées de biologie médicale attire-t-il toujours autant les étudiants en médecine ? Bilan des huit dernières années. *Ann Biol Clin* 2018 ; 76(2) : 125-30.

2. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, *et al.* Active learning increases student performance in science, engineering, and mathematics. *Proc Natl Acad Sci* 2014 ; 111(23) : 8410-5.

3. Ramnanan CJ, Pound LD. Advances in medical education and practice : student perceptions of the flipped classroom. *Adv Med Educ Pract* 2017 ; 8 : 63-73.

4. McCarthy JP, Anderson L. Active learning techniques versus traditional teaching styles : two experiments from history and political science. *Innov High Educ* 2000 ; 24(4) : 279-94.



5. Gauci SA, Dantas AM, Williams DA, Kemm RE. Promoting student-centered active learning in lectures with a personal response system. *Adv Physiol Educ* 2009;33(1):60-71.
6. Abdel Meguid E, Collins M. Students' perceptions of lecturing approaches : traditional versus interactive teaching. *Adv Med Educ Pract* 2017;8:229-41.
7. Bright DR, Reilly Kroustos K, Kinder DH. Audience response systems during case-based discussions : a pilot study of student perceptions. *Curr Pharm Teach Learn* 2013;5(5):410-6.
8. Guarascio AJ, Nemecek BD, Zimmerman DE. Evaluation of students' perceptions of the Socrative application versus a traditional student response system and its impact on classroom engagement. *Curr Pharm Teach Learn* 2017;9(5):808-12.
9. Stoddard HA, Piquette CA. A controlled study of improvements in student exam performance with the use of an audience response system during medical school lectures. *Acad Med* 2010;85(10):S37.
10. Lepiller Q, Solis M, Velay A, Gantner P, Sueur C, Stoll-Keller F, *et al.* Introduction de l'apprentissage par problèmes dans la formation théorique des internes du DES de biologie médicale : évaluation de la satisfaction des internes. *Ann Biol Clin* 2017;75(2):181-92.