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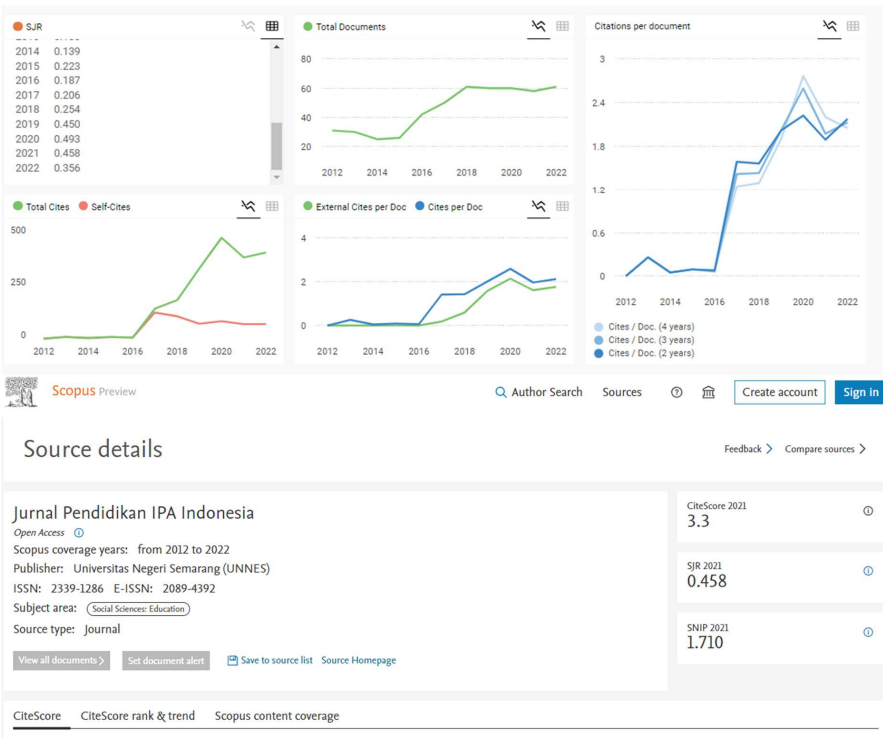
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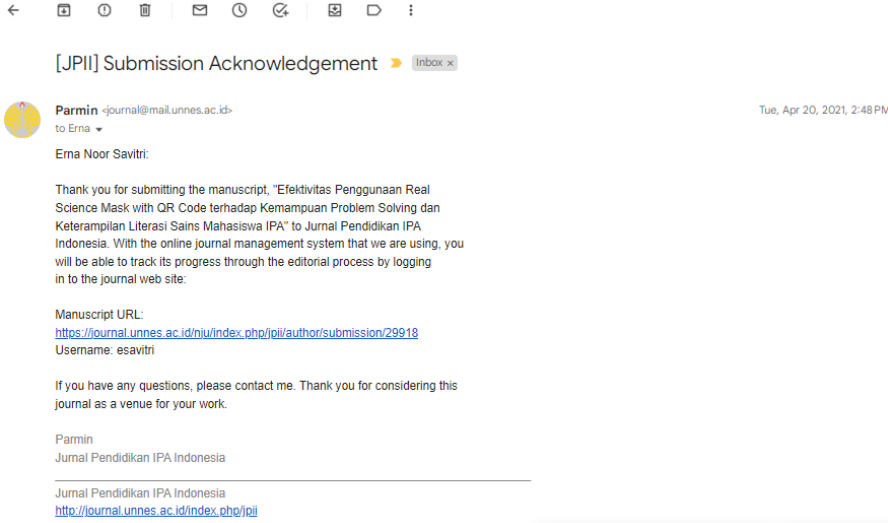
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Kronologi Korespondensi

No	Tanggal	Aktivitas
1	20 April 2021	Submit manuskrip di JPII via OJS
2	26 April 2021	Hasil review tahap 1
3	28 April 2021	Mengirim revisi 1
4	3 Juni 2021	Hasil review 2
5	8 Juni 2021	Mengirim revisi 2
6	10 Juni 2021	Hasil review 3
7	11 Juni 2021	Mengirim revisi 3
8	29 April 2019	Diminta membayar biaya publikasi.
9	3 Juni 2021	Diberikan LoA
10	30 Juni 2021	Artikel terbit

1. Submit manuskrip di JPPII via OJS



The screenshot displays the OJS submission review page for article #29918. The header includes the JPPII logo and the journal title "JURNAL PENDIDIKAN IPA INDONESIA Indonesian Journal of Science Education". The navigation menu contains links for Home, About, User Home, Search, and Archive. The main content area shows the article title "The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy" and lists the authors: E. N. Savitri, A. V. Amalia, S. A. Prabowo, O. E. P. Rahmadani, and A. Kholidah. The submission details include the editor (Stephani Pamelasari), review version (29918-76403-1-RV.docx), and a table of supplementary files.

Supp. files	File Name	Date	Action
	29918-79463-1-SP.pdf	2021-06-30	Present file to reviewers <input checked="" type="checkbox"/> Record
	29918-79464-1-SP.pdf	2021-06-30	Present file to reviewers <input checked="" type="checkbox"/> Record
	29918-79465-1-SP.pdf	2021-06-30	Present file to reviewers <input checked="" type="checkbox"/> Record

2. Hasil review 1 |

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Efektivitas Penggunaan *Real Science Mask with QR Code* terhadap Kemampuan *Problem Solving* dan Keterampilan Literasi Sains Mahasiswa IPA

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui efektivitas penggunaan media belajar *Real Science Mask with QR Code* terhadap kemampuan *Problem Solving* dan keterampilan literasi sains pada mahasiswa. Penelitian ini merupakan jenis penelitian eksperimen yang menggunakan model *Posttest Only Control Design*. Subjek penelitian ini adalah mahasiswa program studi Pendidikan IPA Universitas Negeri Semarang tahun akademik 2020/2021, sampel dari populasi dibagi menjadi kelas eksperimen dan kelas kontrol. Instrumen pengamatan menggunakan lembar observasi yang berdasar pada indikator penilaian aktivitas mahasiswa selama kegiatan pembelajaran. Analisis data pada penelitian ini menggunakan analisis deskriptif kuantitatif, dimana masing-masing nilai rata-rata dideskripsikan pada setiap aspek penilaian berdasarkan pada indikator. Hasil penelitian menunjukkan bahwa kelas eksperimen yang menerapkan media *Real Science Mask with QR Code* memiliki rata-rata skor tertinggi kemampuan *Problem Solving* pada aspek penilaian mendiskusikan kesesuaian fenomena ilmiah dengan skor 9,4 dan keterampilan literasi sains pada aspek penilaian mahasiswa dalam mencari rujukan ilmiah dengan skor 8,8. Rata-rata kedua aspek penilaian tersebut lebih tinggi jika dibandingkan dengan kelas kontrol. Hasil tersebut menunjukkan bahwa media pembelajaran *Real Science Mask with QR Code* efektif untuk meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains pada mahasiswa.

Kata kunci : *Real Science Mask with QR Code*, *Problem Solving*, Literasi Sains

Commented [U2]: INTRODUCTION should:

- contain urgency (importance) to research
- contain a carrying capacity in the form of supporting data and facts
- contain a preliminary study as a basis for the importance of the research conducted
- contain a GAP ANALYSIS Departing from the preliminary study, analysis of published articles formulated in the Gap analysis

GAP ANALYSIS refers to articles published in various internationally reputable journals to emphasize the novelty of research.

- clear limitation of research objectives

Pandemi Covid-19 yang terjadi dalam kurun waktu 2020-2021 menuntut perubahan di semua elemen terutama dalam bidang pendidikan. Kegiatan belajar mengajar yang biasa dilakukan melalui tatap muka, berubah menjadi pembelajaran secara daring (*online*). Adanya perubahan ini menuntut adaptasi dan inovasi dari berbagai pihak baik guru, dosen, siswa maupun mahasiswa. Kegiatan pembelajaran secara daring diharapkan tetap mampu membentuk kepekaan sosial terhadap lingkungan sekitar. Kepekaan sosial peserta didik terhadap lingkungan sekitar sangat dibutuhkan untuk membentuk nilai karakter kepedulian peserta didik. Media pembelajaran yang inovatif dan dapat dilaksanakan secara daring dibutuhkan agar bisa memfasilitasi adanya interaksi sosial peserta didik secara langsung terhadap lingkungan.

Persaingan di era Revolusi 4.0 menuntut semua manusia untuk mampu bersaing secara global, karena teknologi komunikasi yang semakin baik akan membuka akses kompetisi yang sangat lebar dari segala penjuru dunia. Kemampuan *Problem Solving* dan keterampilan literasi sains yang baik diperlukan agar mampu bersaing di era saat ini. Kemampuan *Problem Solving* adalah kemampuan yang berasal dan tumbuh dari sistem kognitif manusia yaitu proses yang terdiri atas empat aktivitas bertahap yang saling berkaitan yaitu mengidentifikasi masalah, memahami masalah, menyelesaikan masalah dan mengevaluasi masalah. *Problem solving* adalah suatu proses mengaplikasikan pengetahuan yang telah diperoleh sebelumnya ke dalam suatu situasi yang baru dan tidak dikenal (Zunanda & Sinulingga, 2015). Kemampuan *Problem Solving* merupakan salah satu kemampuan abad 21 yang harus dimiliki oleh peserta didik. Keterampilan *Problem Solving* dapat menjadikan peserta didik sebagai pribadi yang inovatif, siap sedia bersaing pada abad 21, siap mengubah dunia, siap mengubah perilaku, meningkatkan kemampuan dalam menghadapi masalah, kemampuan memecahkan masalah dan meningkatkan kemampuan dalam hal berpikir menganalisis masalah sampai menemukan solusi dari masalah tersebut. Seseorang yang memiliki kemampuan *Problem Solving* yang baik dapat disebut sebagai pemecah masalah dan siap untuk semua tantangan pada abad 21 (Rahmawati et al., 2019).

Konsep ilmu pengetahuan alam didasarkan pada pengamatan fenomena yang terjadi pada makhluk hidup dan lingkungannya, beberapa hal yang diamati tidak bisa secara kasat mata pada saat pembelajaran. *Real Science Mask with QR Code* merupakan media pembelajaran yang berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. Penggunaan *Real Science Mask with QR Code* diharapkan dapat memfasilitasi kegiatan pembelajaran untuk mengkonkretkan sebuah konsep ilmu IPA yang masih bersifat abstrak dan tidak bisa diamati secara langsung. Selain itu, penggunaannya yang terhubung dengan *google classroom* dapat menyediakan akses tidak terbatas dalam proses pembelajaran sehingga pembelajaran dapat dilakukan dimana saja dan kapan saja. Oleh karena itu diperlukan penelitian terapan untuk pengembangan *Real Science Mask with QR Code* yang diharapkan menjadi sebuah solusi untuk membangun sebuah pengalaman belajar secara konkret serta mampu meningkatkan literasi digital

Commented [U3]: Rahmawati & Prasetyanti?

mahasiswa IPA. Penelitian terapan yang diajukan sesuai dengan Renstra Penelitian UNNES 2016-2020 yakni meningkatkan kemanfaatan ipteks bagi masyarakat sekitarnya melalui kegiatan Tridharma. Selain itu, penelitian terapan ini juga selaras dengan salah satu pilar konservasi UNNES yaitu pilar nilai dan karakter karena penelitian yang dilakukan memiliki nilai inovatif dalam pembelajaran.

Literasi sains didefinisikan sebagai sebuah kemampuan dalam pemanfaatan pengetahuan ilmiah, mengidentifikasi pertanyaan, dan menarik kesimpulan berdasarkan pada bukti nyata, dalam rangka memahami serta membuat keputusan berkenaan dengan alam dan perubahan yang dilakukan terhadap alam melalui aktivitas manusia (OECD, 2003). Bagian yang paling pokok dalam pengembangan literasi sains siswa meliputi pengetahuan tentang sains, proses sains, pengembangan sikap ilmiah, dan pemahaman peserta didik terhadap sains sehingga peserta didik bukan hanya sekedar tahu konsep sains melainkan juga dapat menerapkan kemampuan sains dalam memecahkan berbagai permasalahan dan dapat mengambil keputusan berdasarkan pertimbangan-pertimbangan sains (Yuliati, 2017).

Menurut Poedjadi (Toharudin, et.al, 2011: 2) seseorang memiliki literasi sains dan teknologi ditandai dengan memiliki kemampuan untuk menyelesaikan masalah dengan menggunakan konsep-konsep sains yang diperoleh dalam pendidikan sesuai dengan jenjangnya, mengenal produk teknologi yang ada di sekitarnya beserta dampaknya, mampu menggunakan produk teknologi dan memeliharanya, kreatif dalam membuat hasil teknologi yang disederhanakan sehingga peserta didik mampu mengambil keputusan berdasarkan nilai dan budaya masyarakat.

Tujuan penelitian yang dilakukan adalah untuk menghasilkan media pembelajaran berupa *Real Science Mask with QR Code* yang teruji valid oleh ahli serta layak dari segi keterbacaan dan grafisnya serta memperoleh media pembelajaran yang telah teruji efektif penggunaannya dalam meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA. Penelitian ini mempunyai karakteristik dan keutamaan antara lain: 1) melalui penelitian ini akan dihasilkan media pembelajaran *Real Science Mask with QR Code*, pembelajaran IPA tidak terbatas oleh ruang dan waktu serta dapat meminimalisir biaya yang dikeluarkan; 2) media pembelajaran *Real Science Mask with QR Code* telah dirancang sedemikian rupa sehingga mampu membangun sebuah pengalaman belajar secara konkret dengan menarik dan mudah dipahami; dan 3) hasil penelitian ini diharapkan dapat membantu mahasiswa IPA untuk meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA.

Penelitian yang mengacu pengembangan media pembelajaran IPA baik itu yang berbasis ICT maupun yang berbasis konvensional telah banyak dilakukan sebelumnya. Fatimah & Mufti (2014) telah mengembangkan Media Pembelajaran IPA-Fisika Smartphone Berbasis Android. Permana et al. (2014) telah mengembangkan Media Pembelajaran IPA berbasis Multimedia.

Mulyadi et al. (2016) telah membuat *Media Flash Flipbook*. Rahman et al. (2017) telah membuat Augmented Reality Berbasis Android. Penelitian-penelitian tersebut masih menitikberatkan pada hasil belajar saja. Dalam pengembangannya, peneliti mengadopsi pentingnya kemampuan *Problem Solving* dan keterampilan literasi sains dalam menghadapi Revolusi Industri 4.0 dalam bidang pendidikan.

Hasil penelitian yang mengambil tema tentang kemampuan *Problem Solving* dan keterampilan literasi sains telah dilakukan oleh beberapa peneliti, antara lain penelitian tentang kemampuan pemecahan masalah dapat ditingkatkan dengan menggunakan Strategi Pembelajaran *Thinking Aloud Pair Problem Solving* (Rahmat & Zulaikah, 2014). Selain itu, terdapat pula penelitian pengembangan yang menggunakan *google classroom* untuk meningkatkan keterampilan pemecahan masalah (*Problem Solving*) (Gunawan & Sunarman, 2018) akan tetapi hanya bersifat mengembangkan dan belum menganalisis pengaruh penggunaan media terhadap kemampuan *Problem Solving*. VanLangen et al. (2021) juga melakukan penelitian yang mengukur *virtual learning skills* yang berfokus pada komunikasi mahasiswa. Pada penelitian tersebut mengamati keterampilan belajar virtual tetapi berfokus pada kemampuan komunikasi.

Penelitian terapan yang dilakukan juga memanfaatkan media pembelajaran berbasis IT (teknologi). Media pembelajaran yang digunakan adalah *Real Science Mask with QR Code*, berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. *Real Science Mask with QR Code* sebagai media pembelajaran yang didesain khusus agar dapat meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA. Penelitian penggunaan topeng sains yang terhubung dengan QR Code terintegrasi *google classroom* belum pernah dilakukan.

Problem Solving adalah salah satu keterampilan yang sangat penting dalam pembelajaran (Wahyuni et al., 2017). Belajar untuk memecahkan masalah dapat diperoleh melalui tingkatan pendidikan formal karena pemahaman tentang proses *Problem Solving* masih terbatas (Nayazik, 2017). Keterampilan *Problem Solving* akan membantu peserta didik dalam menyelesaikan masalah, tidak hanya dalam kehidupan akademik tetapi di semua hal dalam kehidupan. Guru membutuhkan banyak informasi mengenai bagaimana membantu peserta didik dalam meningkatkan keterampilan *Problem Solving* agar lebih efisien. Keterampilan *Problem Solving* dapat ditingkatkan melalui pendidikan dan menjadi tujuan pembelajaran yang penting (Armağan et al., 2009).

Proses *Problem Solving* dijelaskan sebagai proses kompleks yang membutuhkan banyak kemampuan yang digunakan bersama. Unsur-unsur dari proses ini adalah memahami masalah, memilih informasi yang diperlukan, mengubah informasi yang diperoleh menjadi rancangan solusi, dan mencapai solusi setelah melakukan rancangan yang telah dibuat (Saygılı, 2017). Solusi yang dicapai melalui penguasaan proses *Problem Solving* dan menggunakan metode yang tepat

Commented [U4]: Gunawan & Sugarman?

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tidak hanya akan menyelesaikan masalah itu saja, tetapi juga akan menjadi solusi yang lebih efektif untuk masalah serupa pada kemudian hari (Kirmizi *et al.*, 2015).

Masalah dalam sains adalah gagasan yang penting untuk membangun kapasitas *Problem Solving* peserta didik dan menjadikan pelajaran sains lebih menyenangkan serta memotivasi peserta didik untuk berprestasi lebih baik. Kemampuan *Problem Solving* digunakan dalam memecahkan masalah sains dalam bentuk matematika dan memecahkan permasalahan atas fenomena yang terjadi di lingkungan. Namun pada kenyataannya, peserta didik mengalami kesulitan karena strategi yang diajarkan dalam pembelajaran hanya untuk menyelesaikan masalah yang memerlukan perhitungan matematis (Wahyuni *et al.*, 2017).

Indikator kemampuan *Problem Solving* menurut Polya, sebagaimana dikutip oleh (Jayadiningrat & Ati, 2018) yaitu: (1) Memahami masalah, (2) Merencanakan penyelesaian, (3) Menyelesaikan masalah sesuai rencana, (4) Melakukan pengecekan kembali terhadap semua langkah. Peneliti telah menemukan bahwa kemampuan *Problem Solving* peserta didik dapat dilatih dan difasilitasi melalui integrasi strategi *Problem Solving* dan teknologi komputer. Kemampuan *Problem Solving* telah diakui sebagai kemampuan penting untuk beradaptasi dengan lingkungan di abad ke-21. Peran pendidikan di abad ke-21 harus mempersiapkan peserta didik untuk memenuhi tantangan dunia yang dinamis dan saling berhubungan. Kemampuan *Problem Solving* adalah kemampuan untuk menggunakan logika untuk memecahkan masalah kehidupan nyata dan membuat keputusan (Gunawan *et al.*, 2017).

Kemampuan pemecahan masalah merupakan kompetensi strategik agar peserta didik mampu memahami, memilih pendekatan dan strategi dalam pemecahan suatu masalah (Tanjung & Nababan, 2019). Adapun prosedur dalam pemecahan masalah adalah menemukan dan memecahkan penyebab utama dari suatu masalah. Pada kegiatan ini diperlukan kemampuan mengidentifikasi dan menganalisis penyebab dari permasalahan, menghasilkan berbagai solusi, dan menerapkannya.

Ciri-ciri peserta didik menguasai kemampuan *Problem Solving* menurut Pisaba (2018) disajikan dalam tabel berikut ini :

Tabel 1.2 Ciri-ciri peserta didik menguasai kemampuan *Problem Solving*

No	Indikator	Ciri – ciri
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Commented [U6]: Table 1?

1	Memahami masalah	Keterangan yang diberikan cukup untuk mencari apa yang ditanyakan.
2	Merencanakan penyelesaian	Menemukan soal sebelumnya, memperhatikan persoalan yang ditanyakan, memikirkan apakah solusi yang digunakan untuk soal sebelumnya dapat digunakan untuk masalah ini.
3	Menyelesaikan masalah sesuai rencana	Melakukan strategi yang benar untuk menyelesaikan masalah
4	Melakukan pengecekan kembali proses dan hasil	Memeriksa kebenaran jawaban, apakah langkah yang dilakukan sesuai rencana, dan dapat digunakan untuk soal lain.

Komaridah (2011) juga mengemukakan bahwa kemampuan *Problem Solving* memiliki 3 ciri utama, yaitu : (1) *Problem Solving* merupakan rangkaian aktivitas pembelajaran, artinya dalam implementasi *Problem Solving* ada sejumlah kegiatan yang harus dilakukan peserta didik. *Problem Solving* mendorong peserta didik untuk aktif berpikir, berkomunikasi, mencari dan mengolah data, dan akhirnya menyimpulkan; (2) Aktivitas pembelajaran diarahkan untuk menyelesaikan masalah. *Problem Solving* menempatkan masalah sebagai kata kunci dari proses pembelajaran. Artinya, tanpa masalah maka tidak mungkin ada proses pembelajaran; (3) Pemecahan masalah dilakukan dengan menggunakan pendekatan berpikir secara ilmiah. Berpikir dengan menggunakan metode ilmiah adalah proses berpikir deduktif dan induktif. Proses berpikir ini dilakukan secara sistematis dan empiris. Sistematis artinya berpikir ilmiah dilakukan melalui tahapan-tahapan tertentu; sedangkan empiris artinya proses penyelesaian masalah didasarkan pada data dan fakta yang jelas.

Perbedaan antara peserta didik yang memiliki kemampuan rendah (novice) dan tinggi (expert) dalam pemecahan masalah adalah bagaimana peserta didik mengorganisasi dan menggunakan pengetahuan, serta menghubungkan satu konsep dengan konsep yang lain ketika memecahkan masalah (Shih & Singh, 2013). Peserta didik yang memiliki kemampuan tinggi dalam pemecahan masalah cenderung menggunakan argumen kualitatif berdasarkan konsep yang mendasari masalah (deep feature), mengevaluasi solusi, dan cenderung menggunakan alat bantu representasi. Hal sebaliknya, peserta didik yang memiliki kemampuan rendah dalam pemecahan

masalah IPA cenderung mengenali masalah berdasarkan sajian masalah (surface feature), tidak melakukan evaluasi, dan cenderung menggunakan rumus dalam memecahkan masalah (De Cock, 2012).

Kelebihan yang dimiliki oleh peserta didik apabila menguasai kemampuan pemecahan masalah yaitu (1) Dapat membuat peserta didik lebih menghayati kehidupan sehari-hari, (2) Dapat melatih dan membiasakan peserta didik untuk menghadapi dan memecahkan masalah secara terampil, (3) Dapat mengembangkan kemampuan berfikir peserta didik secara kreatif, (4) Peserta didik sudah mulai dilatih untuk memecahkan masalahnya, (5) Peserta didik akan menunjukkan sikap aktif berfikir dan bertindak kreatif (6) Dalam kehidupan nyata peserta didik dapat memecahkan masalah yang dihadapi, (7) Peserta didik dapat mengidentifikasi dan melakukan penyelidikan (8) Dalam kegiatan pengamatan peserta didik dapat menafsirkan dan mengevaluasi hasil dari pengamatan tersebut, (9) Merangsang perkembangan kemajuan berfikir peserta didik untuk menyelesaikan masalah yang dihadapi dengan tepat, (10) Dapat membuat pendidikan sekolah lebih relevan dengan kehidupan, khususnya dunia kerja.

METODE

Penelitian ini menggunakan metode eksperimen. Metode eksperimen adalah metode penelitian yang digunakan untuk mencari pengaruh perlakuan tertentu terhadap variable yang lain dalam kondisi yang terkendali (Sugiyono, 2013). Penelitian dengan metode eksperimen ini menggunakan kelas eksperimen yang menerapkan penggunaan *Real Science Mask with QR Code* dalam kegiatan perkuliahan dan menerapkan kelas kontrol sebagai perbandingan yang menerapkan metode perkuliahan dengan media teks dalam power point. Media pembelajaran yang digunakan pada kelas eksperimen adalah *Real Science Mask with QR Code*, berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. *Real Science Mask with QR Code* sebagai media pembelajaran yang didesain khusus agar dapat meningkatkan literasi sains mahasiswa IPA.

Kegiatan pembelajaran menggunakan *Real Science Mask with QR Code* dilaksanakan dalam beberapa tahapan, diantaranya adalah : 1) Tahap pengenalan media, 2) Tahap pemanfaatan media *Real Science Mask with QR Code* dengan menggunakan aplikasi scanning barcode yang ada pada smartphone mahasiswa, 3) Tahap pemanfaatan platform aplikasi digital yang terhubung dengan *Real Science Mask with QR Code*, diantaranya adalah website, *google classroom*, dan *google drive*. Mahasiswa selama kegiatan pembelajaran menggunakan *Real Science Mask with QR Code* diamati aktivitas belajarnya pada kemampuan *Problem Solving* dan penguasaan literasi sains. Desain Penelitian menggunakan desain *Posttest Only Control Design*, yaitu terdapat kelas eksperimen dengan perlakuan *Real Science Mask with QR Code* dan kelas kontrol yang diberikan perlakuan media dalam power point. Variabel yang diamati ada 2 jenis, yaitu kemampuan *Problem Solving*

Commented [U7]: METHODS should

- contain detailed research stages
- Each stage is explained and analyzed by what method
- Data analysis must be with clear references
- The research instruments used were elaborated to the data analysis technique
- It is hoped that there will be a modification in the stages of research from sources referred by the researcher

Commented [U8]: cannot be found in the references.

dan keterampilan Literasi Sains. Adapun desain penelitian tergambar pada ilustrasi di bawah ini :

R ₁	X	O ₁	O ₃
R ₂		O ₂	O ₄

Keterangan :

R₁ : Kelas Eksperimen

R₂ : Kelas Kontrol

X : Perlakuan Media

O₁, O₂ : Kemampuan *Problem Solving*

O₃, O₄ : Kemampuan Literasi Sains

Subjek dalam penelitian ini adalah mahasiswa Program Studi Pendidikan IPA Terpadu dalam mata kuliah Biologi Dasar di Universitas Negeri Semarang (UNNES). Respon mahasiswa yang diamati adalah pada kemampuan *Problem Solving* dan Literasi Sains dengan menggunakan angket. Teknik pengumpulan data dalam penelitian ini antara lain: a) Survei awal, untuk menentukan sampel pada kelas eksperimen dan kelas kontrol. b) Pelaksanaan penelitian pada perkuliahan Biologi Dasar menggunakan media *Real Science Mask with QR Code*. c) Pengambilan data berupa nilai ujian menggunakan soal tes tertulis yang telah memenuhi kriteria pengukuran kemampuan *Problem Solving* dan literasi sains. d) Analisis Data, nilai kemampuan *Problem Solving* dan keterampilan literasi sains selanjutnya dianalisis secara deskriptif kuantitatif.

HASIL DAN PEMBAHASAN

Kegiatan pembelajaran dengan memanfaatkan media *Real Science Mask with QR Code* mengajak mahasiswa untuk bersikap peduli terhadap permasalahan yang telah disajikan dalam gambar pada topeng, melalui QR Code yang tercetak dalam topeng mahasiswa diajak untuk melakukan pemindaian kode yang akan menghantarkan ke dalam aplikasi yang terkait untuk mencari solusi permasalahan yang dihadapi. Aplikasi yang terkait dalam QR Code diantaranya website, google classroom, drive. Aktivitas mahasiswa selama melaksanakan kegiatan pembelajaran diamati dari aspek kemampuan *Problem Solving* dan Keterampilan literasi sains.

Commented [U9]: RESULTS AND DISCUSSION

- Tables or graphs (one selected) must represent different results
 - The results of data analysis must be strong in answering the analysis gap
 - Display of results other than those narrated in table-graph-image-modeling
 - The research novelty has not been clear enough
 - It is recommended not to repeat the references in the introduction, using previous research findings.
 - References used should be taken from reputable journals.
- It is necessary to explain the specifications of the findings in this study that show

Indikator kemampuan *Problem Solving* yang digunakan adalah : 1) memahami masalah. 2) merencanakan pemecahannya. 3) menyelesaikan masalah sesuai perencanaannya. 4) memeriksa kembali hasil yang diperoleh (Dewi, 2019). Dalam pengamatan aktivitas belajar mahasiswa, indikator kemampuan *Problem Solving* dijabarkan dalam beberapa aspek penilaian yang disesuaikan dengan pola kegiatan pembelajaran pada kelas eksperimen maupun pada kelas kontrol. Aspek penilaian kemampuan *Problem Solving* yang dikembangkan berdasarkan indicator tersebut diantaranya adalah : menganalisis fenomena yang sudah disajikan dalam media pembelajaran, menyusun tindak lanjut terkait dengan fenomena ilmiah, realisasi pelaksanaan sesuai dengan kaidah ilmiah, mendeskripsikan fenomena ilmiah yang dihadapi sesuai dengan fakta, melaporkan hasil pengamatan, mendiskusikan kesesuaian fenomena ilmiah dengan fakta, mampu mencari rujukan ilmiah yang terkait dengan fenomena yang dihadapi, mengkolaborasikan hasil rujukan ilmiah dengan hasil analisis mandiri, mempublikasikan hasil analisis melalui media rujukan ilmiah.

Tabel 1. Hasil Penilaian Kemampuan *Problem Solving*

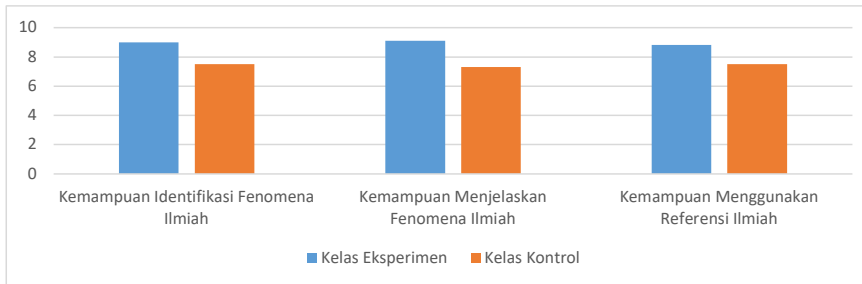
Indikator	Pengembangan Aspek Penilaian	Rata – Rata Nilai	
		Kelas Eksperimen	Kelas Kontrol
Kemampuan Identifikasi Fenomena Ilmiah	1. Menganalisis fenomena yang sudah disajikan dalam media pembelajaran	9,2	7,2
	2. Menyusun tindak lanjut terkait dengan fenomena ilmiah	9,0	7,5
	3. Realisasi pelaksanaan sesuai dengan kaidah ilmiah	8,8	8,0
Kemampuan Menjelaskan Fenomena Ilmiah	1. Mendeskripsikan fenomena ilmiah yang dihadapi sesuai dengan fakta	9,3	7,0
	2. Melaporkan hasil pengamatan	8,7	7,8
	3. Mendiskusikan kesesuaian fenomena ilmiah dengan fakta	9,4	7,1
Kemampuan Menggunakan Referensi Ilmiah	1. Mampu mencari rujukan ilmiah yang terkait dengan fenomena yang dihadapi	8,5	7,4
	2. Mengkolaborasikan hasil rujukan ilmiah dengan hasil analisis mandiri	8,7	7,0

3. Mempublikasikan hasil analisis melalui media rujukan ilmiah	9,1	8,0
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Nilai rata-rata tertinggi pada kelas eksperimen dicapai pada aspek mendiskusikan kesesuaian fenomena ilmiah dengan fakta yang terjadi, hal tersebut membuktikan bahwa penggunaan gambar awal yang disajikan pada topeng *Real Science Mask* akan membangkitkan minat mahasiswa untuk berdiskusi. Diskusi dilakukan dengan tujuan untuk membuktikan hipotesa awal mengenai permasalahan pada gambar topeng *Real Science Mask* dengan fakta sebenarnya, dimana beberapa kebenaran tersebut sudah tersedia dalam materi di platform aplikasi lain yang terhubung pada *QR Code*, sehingga mahasiswa bisa berdiskusi dengan sesama mahasiswa, dosen berdasar pada pedoman materi belajar.

Nilai rata-rata terendah ditemukan pada kelas kontrol bagian aspek penilaian mendeskripsikan fenomena ilmiah yang sesuai dengan fakta, dan aspek penilaian mengkolaborasi hasil rujukan ilmiah dengan analisis mandiri. Kedua aspek tersebut nilainya rendah, karena pada kelas kontrol tidak menerapkan media belajar *Real Science Mask with QR Code*, sehingga mahasiswa tidak bisa mendeskripsikan permasalahan awal secara jelas dan berlanjut pada kesulitan mahasiswa untuk mengkolaborasi dengan sumber rujukan ilmiah.

Dengan demikian penggunaan media *Real Science Mask with QR Code* telah terbukti bisa meningkatkan rasa ingin tahu mahasiswa pada permasalahan yang disajikan, dan berusaha menemukan solusi dan jawaban menggunakan beberapa acuan keterampilan literasi sains yang telah dikuasainya.



Gambar 1. Perbandingan Kemampuan *Problem Solving* kelas Kontrol dan Eksperimen

Berdasarkan data penelitian, rata-rata nilai aspek penilaian yang tertinggi dicapai oleh indikator kemampuan menjelaskan fenomena ilmiah yang berada pada nilai 9,3. Fakta perolehan nilai tersebut menunjukkan bahwa dengan modal awal berupa gambar yang tersaji dalam *Real Science Mask with QR Code* bisa mengajak mahasiswa untuk

mengasah kemampuan *Problem Solving* dengan didukung keterampilan literasi sains yang baik sehingga bisa membuka penjelasan fenomena ilmiah yang sedang dihadapi.

Kelebihan pembelajaran *Problem Solving* menurut Haryanti (2010) adalah : 1) Mendidik siswa untuk berpikir sistematis, 2) Mampu mencari jalan keluar terhadap situasi yang dihadapi, 3) Belajar menganalisis suatu masalah dari berbagai aspek, 4) Mendidik siswa percaya diri sendiri, 5) Berpikir dan bertindak kreatif, 6) Memecahkan masalah yang dihadapi secara realistis, 7) Dapat membuat pendidikan sekolah lebih relevan dengan kehidupan, khususnya dunia kerja, 8) Merangsang perkembangan kemajuan berpikir siswa untuk menyelesaikan masalah yang dihadapi dengan tepat. Kelemahan pembelajaran *Problem Solving* : 1) Memerlukan waktu yang cukup banyak, 2) Kemampuan siswa dalam memecahkan masalah berbeda beda ada yang sempurna dalam memecahkan masalah tetapi ada juga yang kurang dalam memecahkan masalah.

Indikator keterampilan literasi sains menurut PISA diantaranya adalah : 1) Mengidentifikasi masalah ilmiah untuk penyelidikan ilmiah. 2) Menjelaskan fenomena ilmiah untuk menggambarkan atau menafsirkan fenomena ilmiah dan memberikan penjelasan. 3) Menggunakan bukti ilmiah untuk mendukung prediksi, membuat kesimpulan dan mengkomunikasikan (Bybee, 2009). Indikator keterampilan sains merupakan representasi dari setiap kegiatan ilmiah yang dilaksanakan selama kegiatan pembelajaran, sehingga disesuaikan dengan beberapa aspek penilaian sebagai dasar untuk penyusunan angket. Kegiatan pembelajaran mahasiswa yang mencerminkan indikator penilaian keterampilan Literasi Sains diukur dalam beberapa aspek penilaian berikut : mengidentifikasi isu permasalahan yang dihadapi, mengklasifikasikan jenis permasalahan, menganalisis latar belakang permasalahan, merencanakan tindakan untuk mengatasi permasalahan, melakukan tindakan nyata untuk mengatasi permasalahan, mencari sumber/rujukan ilmiah terkait dengan permasalahan, melaksanakan refleksi secara menyeluruh dari semua tindakan yang sudah dilakukan, menerima kritik dan saran terkait dengan proses yang sudah dilakukan.

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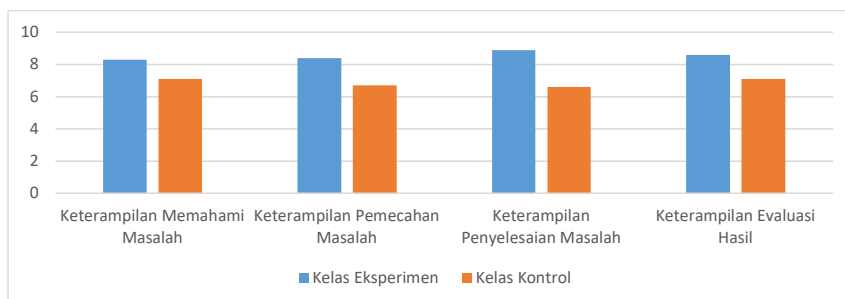
Tabel 2. Hasil Keterampilan Literasi Sains

Indikator	Pengembangan Aspek Penilaian	Rata – Rata Nilai	
		Kelas Eksperimen	Kelas Kontrol
	1. Mengidentifikasi isu permasalahan yang dihadapi	8,5	7,0

Keterampilan Memahami Masalah	2. Mengklasifikasikan jenis permasalahan	8,2	7,3
Keterampilan Pemecahan Masalah	1. Menganalisis latar belakang permasalahan	8,4	6,8
	2. Merencanakan Tindakan untuk mengatasi permasalahan	8,5	6,6
Keterampilan Penyelesaian Masalah	1. Melakukan Tindakan nyata untuk mengatasi permasalahan	9,1	6,7
	2. Mencari sumber/rujukan ilmiah terkait dengan permasalahan	8,8	6,5
Keterampilan Evaluasi Hasil	1. Melaksanakan refleksi secara menyeluruh dari semua Tindakan yang sudah dilakukan	8,7	7,0
	2. Menerima kritik dan saran terkait dengan proses yang sudah dilakukan	8,5	7,2

Pada aspek penilaian melakukan tindakan nyata untuk mengatasi permasalahan, menunjukkan rata-rata nilai yang paling tinggi yaitu 9,1. Kondisi tersebut membuktikan bahwa media *REAL SCIENCE MASK with QR Code* membuat rasa keingintahuan mahasiswa menjadi sangat besar, sehingga terpacu untuk mengembangkan keterampilan literasi sains yang dimiliki mahasiswa. Semua Tindakan nyata yang dilakukan untuk memecahkan permasalahan yang dihadapi harus memiliki pedoman secara ilmiah, bukti Tindakan ilmiah mahasiswa yang meningkat tersebut mencerminkan penguasaan kemampuan literasi sains yang baik.

Pada kelas kontrol yang tidak menerapkan media *REAL SCIENCE MASK with QR Code*, rata-rata nilai terendah berada pada aspek penilaian dalam mencari sumber/rujukan ilmiah terkait dengan permasalahan. Mahasiswa tidak mempunyai gambaran permasalahan yang jelas, sehingga keinginan untuk menemukan sebuah solusi pemecahan masalah juga sangat rendah. Dari fakta yang terjadi dalam kelas kontrol, maka bisa disimpulkan tanpa adanya masalah yang jelas, mahasiswa tidak mempunyai keinginan kuat untuk mencari sumber rujukan ilmiah.



Gambar 2. Penilaian Keterampilan Literasi Sains

Dari grafik yang menunjukkan rata-rata nilai keterampilan literasi sains yang dikuasai mahasiswa, aspek penilaian keterampilan penyelesaian masalah memperoleh rata-rata nilai yang paling tinggi sebesar 8,9. Penggunaan media *REAL SCIENCE MASK with QR Code* yang terintegrasi dengan beberapa platform aplikasi digital lainnya bisa memberikan fasilitas kepada mahasiswa untuk melakukan perencanaan dan Tindakan nyata dalam rangka untuk menemukan sebuah solusi sebagai dasar pemecahan masalah yang tengah dihadapi. Penyajian gambar di awal yang tidak memiliki keterangan tertulis membuat rasa ingin tahu mahasiswa yang semakin kuat, dilengkapi dengan adanya sebuah *QR Code* maka semakin meningkatkan keinginan mahasiswa untuk segera menemukan sebuah jawaban yang sesuai dengan gambar pada topeng *Real Science Mask*.

SIMPULAN

Kegiatan pembelajaran pada masa pandemi Covid-19 tidak diperbolehkan untuk melaksanakan kegiatan tatap muka, agar kerumunan mahasiswa yang terjadi di kelas bisa dihindari. Kegiatan pembelajaran dilaksanakan secara daring, sehingga diperlukan sebuah inovasi secara simultan agar kegiatan pembelajaran tidak cepat membosankan dan bisa mencapai tujuan belajar yang diinginkan. Topeng *Real Science Mask with QR Code* adalah sebuah inovasi pada bidang media belajar yang terintegrasi dengan beberapa platform digital youtube, drive, dan website. Hasil penelitian menunjukkan bahwa pada kemampuan *Problem Solving* aspek kemampuan menjelaskan fenomena ilmiah memiliki porsi nilai tertinggi, dan pada keterampilan literasi sains aspek keterampilan menyelesaikan masalah juga memperoleh nilai tertinggi. Kedua hasil tersebut menunjukkan bahwa *REAL SCIENCE MASK with QR Code* bisa sebagai solusi alternatif

media yang bisa meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains.

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2. For books, please refer to the original/primary book reference no matter the date.

3. All of the listed references must be cited in the body of the article, and vice versa.

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Commented [U12]: Mention all the authors' names.

Paper title:

Efektivitas Penggunaan *Real Science Mask with QR Code* terhadap Kemampuan *Problem Solving* dan Keterampilan Literasi Sains Mahasiswa IPA

Parts of review	Guidelines	Yes	Partly	No	Reviewer's note for improvement	Author's responds (highlight of revision)
Title	• Does the subject matter fit within the scope of journal?	√				
	• Does the title clearly and sufficiently reflect its contents?		√			
Abstract	• Does the abstract contain informative, including Background, Methods, Results and Conclusion?		√			
Back-ground	• Is the background informative and sufficient (include the background problem and objectives)?		√			
	• Is research question of the study clear and understandable?		√			
	• Does the rationale of the study clearly explained using relevant literature?		√			
Methods	• Is the "aim" of the manuscript clear and understandable?		√			
	• Is the methodology chosen suitable to the nature of the topic studied?		√			
	• Is the methodology of the research described clearly?(including study design, location, subjects, data collection, data analysis)		√			
	• Is there adequate information about the data collection tools used? (only for empirical studies)		√			
	• Are the validity and reliability of data collection tools established? (only for empirical studies)	√				
Results & Discussion	• Are the data collection tools suitable for the methodology of the study? (only for empirical studies)	√				
	• Are the tables, graphs and pictures understandable, well presented and numbered consecutively?	√				
	• Do the data analysis and the interpretation appropriate to the problem and answer the objectives?		√			
	• Does the "discussion" section of the manuscript adequately relate to the current and relevant literature?		√			
Conclusion	• Are the findings discussed adequately considering the research question(s), sub-question(s) or hypothesis?		√			
	• Is the conclusion clear and in the form of a narration instead of pointers?		√			
References	• Isn't the conclusion a summary and consistent between problems, objectives and conclusion?		√			
	• Do the references and citations match?		√			
References	• Are the writing of references correct?		√			

Quality Criteria	• Do the title, problem, objectives, methods and conclusion are in line? Is it well organized?		√			
	• The quality of the language is satisfactory		√			
	• The work relevant and novel		√			
	• Are there strong consistencies among the parts of the manuscript? (introduction, methods, results and discussion, and conclusion)		√			

3. Mengirim revisi 1

Efektivitas *Real Science Mask with QR Code* terhadap Kemampuan *Problem Solving* dan Keterampilan Literasi Sains Mahasiswa IPA

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Penelitian ini bertujuan untuk mengetahui efektivitas penggunaan media belajar *Real Science Mask with QR Code* terhadap kemampuan *Problem Solving* dan keterampilan literasi sains pada mahasiswa. Penelitian ini merupakan jenis penelitian eksperimen yang menggunakan model *Posttest Only Control Design*. Subjek penelitian ini adalah mahasiswa program studi Pendidikan IPA Universitas Negeri Semarang tahun akademik 2020/2021, sampel dari populasi dibagi menjadi kelas eksperimen dan kelas kontrol. Instrumen pengamatan menggunakan lembar observasi yang berdasar pada indikator penilaian aktivitas mahasiswa selama kegiatan pembelajaran. Analisis data pada penelitian ini menggunakan analisis deskriptif kuantitatif, dimana masing - masing nilai rata-rata dideskripsikan pada setiap aspek penilaian berdasarkan pada indikator. Hasil penelitian menunjukkan bahwa kelas eksperimen yang menerapkan media *Real Science Mask with QR Code* memiliki rata-rata skor tertinggi kemampuan *Problem Solving* pada aspek penilaian mendiskusikan kesesuaian fenomena ilmiah dengan skor 9,4 dan keterampilan literasi sains pada aspek penilaian mahasiswa dalam mencari rujukan ilmiah dengan skor 8,8. Rata-rata kedua aspek penilaian tersebut lebih tinggi jika dibandingkan dengan kelas kontrol. Hasil tersebut menunjukkan bahwa media pembelajaran *Real Science Mask with QR Code* efektif untuk meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains pada mahasiswa.

Kata kunci : *Real Science Mask with QR Code*, *Problem Solving*, Literasi Sains

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PENDAHULUAN

Pandemi Covid-19 yang terjadi dalam kurun waktu 2020-2021 menuntut perubahan di semua elemen terutama dalam bidang pendidikan. Kegiatan belajar mengajar yang biasa dilakukan melalui tatap muka, berubah menjadi pembelajaran secara daring (*online*). Adanya perubahan ini menuntut adaptasi dan inovasi dari berbagai pihak baik guru, dosen, siswa maupun mahasiswa. Kegiatan pembelajaran secara daring diharapkan tetap mampu membentuk kepekaan sosial terhadap lingkungan sekitar. Kepekaan sosial peserta didik terhadap lingkungan sekitar sangat dibutuhkan untuk membentuk nilai karakter kepedulian peserta didik. Media pembelajaran yang inovatif dan dapat dilaksanakan secara daring dibutuhkan agar bisa memfasilitasi adanya interaksi sosial peserta didik secara langsung terhadap lingkungan.

Persaingan di era Revolusi 4.0 menuntut semua manusia untuk mampu bersaing secara global, karena teknologi komunikasi yang semakin baik akan membuka akses kompetisi yang sangat lebar dari segala penjuru dunia. Kemampuan *Problem Solving* dan keterampilan literasi sains yang baik diperlukan agar mampu bersaing di era saat ini. Kemampuan *Problem Solving* adalah kemampuan yang berasal dan tumbuh dari sistem kognitif manusia yaitu proses yang terdiri atas empat aktivitas bertahap yang saling berkaitan yaitu mengidentifikasi masalah, memahami masalah, menyelesaikan masalah dan mengevaluasi masalah. *Problem solving* adalah suatu proses mengaplikasikan pengetahuan yang telah diperoleh sebelumnya ke dalam suatu situasi yang baru dan tidak dikenal (Zunanda & Sinulingga, 2015). Kemampuan *Problem Solving* merupakan salah satu kemampuan abad 21 yang harus dimiliki oleh peserta didik. Keterampilan *Problem Solving* dapat menjadikan peserta didik sebagai pribadi yang inovatif, siap sedia bersaing pada abad 21, siap mengubah dunia, siap mengubah perilaku, meningkatkan kemampuan dalam menghadapi masalah, kemampuan memecahkan masalah dan meningkatkan kemampuan dalam hal berpikir menganalisis masalah sampai menemukan solusi dari masalah tersebut. Seseorang yang memiliki kemampuan *Problem Solving* yang baik dapat disebut sebagai pemecah masalah dan siap untuk semua tantangan pada abad 21 (Rahmawati & Prasetyanti, 2019).

Konsep ilmu pengetahuan alam didasarkan pada pengamatan fenomena yang terjadi pada makhluk hidup dan lingkungannya, beberapa hal yang diamati tidak bisa secara kasat mata pada saat pembelajaran. *Real Science Mask with QR Code* merupakan media pembelajaran yang berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. Penggunaan *Real Science Mask with QR Code* diharapkan dapat memfasilitasi kegiatan pembelajaran untuk mengkonkretkan sebuah konsep ilmu IPA yang masih bersifat abstrak dan tidak bisa diamati secara langsung. Selain itu, penggunaannya yang terhubung dengan *google classroom* dapat menyediakan akses tidak terbatas dalam proses pembelajaran sehingga pembelajaran dapat dilakukan dimana saja dan kapan saja. Oleh karena itu diperlukan penelitian terapan untuk pengembangan *Real Science Mask with QR Code* yang diharapkan menjadi sebuah solusi untuk membangun sebuah pengalaman belajar secara konkret serta mampu meningkatkan literasi digital mahasiswa IPA. Penelitian terapan yang diajukan sesuai dengan Renstra Penelitian UNNES 2016-2020 yakni meningkatkan kemanfaatan ipteks bagi masyarakat sekitarnya melalui kegiatan Tridharma. Selain itu, penelitian terapan ini juga selaras dengan salah satu pilar konservasi UNNES yaitu pilar nilai dan karakter karena penelitian yang dilakukan memiliki nilai inovatif dalam pembelajaran.

Literasi sains didefinisikan sebagai sebuah kemampuan dalam pemanfaatan pengetahuan ilmiah, mengidentifikasi pertanyaan, dan menarik kesimpulan berdasarkan pada bukti nyata, dalam rangka memahami serta membuat keputusan berkenaan dengan alam dan perubahan yang dilakukan terhadap alam melalui aktivitas manusia (OECD, 2003). Bagian yang paling pokok dalam pengembangan literasi sains siswa meliputi pengetahuan tentang sains, proses sains, pengembangan sikap ilmiah, dan pemahaman peserta didik terhadap sains sehingga peserta didik bukan hanya sekedar tahu konsep sains melainkan juga dapat menerapkan kemampuan sains dalam memecahkan berbagai permasalahan dan dapat mengambil keputusan berdasarkan pertimbangan-pertimbangan sains (Yuliati, 2017).

Menurut Poedjiadi (Toharudin, et.al, 2011: 2) seseorang memiliki literasi sains dan teknologi ditandai dengan memiliki kemampuan untuk menyelesaikan masalah dengan menggunakan konsep-konsep sains yang diperoleh dalam pendidikan sesuai dengan jenjangnya, mengenal produk teknologi yang ada di sekitarnya beserta dampaknya, mampu menggunakan produk teknologi dan memeliharanya, kreatif dalam membuat hasil teknologi yang disederhanakan sehingga peserta didik mampu mengambil keputusan berdasarkan nilai dan budaya masyarakat.

Penelitian yang mengacu pengembangan media pembelajaran IPA baik itu yang berbasis ICT maupun yang berbasis konvensional telah banyak dilakukan sebelumnya. Fatimah & Mufti (2014) telah mengembangkan Media Pembelajaran IPA-Fisika Smartphone Berbasis Android. Permana et al. (2014) telah mengembangkan Media Pembelajaran IPA berbasis Multimedia. Mulyadi et al. (2016) telah

membuat *Media Flash Flipbook*. Rahman et al. (2017) telah membuat Augmented Reality Berbasis Android. Penelitian-penelitian tersebut masih menitikberatkan pada hasil belajar saja. Dalam pengembangannya, peneliti mengadopsi pentingnya kemampuan *Problem Solving* dan keterampilan literasi sains dalam menghadapi Revolusi Industri 4.0 dalam bidang pendidikan.

Hasil penelitian yang mengambil tema tentang kemampuan *Problem Solving* dan keterampilan literasi sains telah dilakukan oleh beberapa peneliti, antara lain penelitian tentang kemampuan pemecahan masalah dapat ditingkatkan dengan menggunakan Strategi Pembelajaran *Thinking Aloud Pair Problem Solving* (Rahmat & Zulaikah, 2014). Selain itu, terdapat pula penelitian pengembangan yang menggunakan *google classroom* untuk meningkatkan keterampilan pemecahan masalah (*Problem Solving*) (Gunawan & Suarman, 2018) akan tetapi hanya bersifat mengembangkan dan belum menganalisis pengaruh penggunaan media terhadap kemampuan *Problem Solving*. VanLangen et al. (2021) juga melakukan penelitian yang mengukur *virtual learning skills* yang berfokus pada komunikasi mahasiswa. Pada penelitian tersebut mengamati keterampilan belajar virtual tetapi berfokus pada kemampuan komunikasi.

Gap analisis penelitian yang dilakukan dibandingkan dengan penelitian sebelumnya yaitu meskipun menggunakan teknologi dan harus dilaksanakan secara online, tetapi media yang dibuat juga bisa digunakan secara offline, sehingga memudahkan peserta didik dalam menggunakan media tersebut. Penelitian yang dilakukan bertujuan untuk menghasilkan media pembelajaran berupa *Real Science Mask with QR Code* yang teruji valid oleh ahli serta layak dari segi keterbacaan dan grafisnya serta memperoleh media pembelajaran yang telah teruji efektif penggunaannya dalam meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA. Penelitian ini mempunyai karakteristik dan keutamaan antara lain: 1) melalui penelitian ini akan dihasilkan media pembelajaran *Real Science Mask with QR Code*, pembelajaran IPA tidak terbatas oleh ruang dan waktu serta dapat meminimalisir biaya yang dikeluarkan; 2) media pembelajaran *Real Science Mask with QR Code* telah dirancang sedemikian rupa sehingga mampu membangun sebuah pengalaman belajar secara konkret dengan menarik dan mudah dipahami; dan 3) hasil penelitian ini diharapkan dapat membantu mahasiswa IPA untuk meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA.

Penelitian terapan yang dilakukan juga memanfaatkan media pembelajaran berbasis IT (teknologi). Media pembelajaran yang digunakan adalah *Real Science Mask with QR Code*, berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. *Real Science Mask with QR Code* sebagai media pembelajaran yang didesain khusus agar dapat meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains mahasiswa IPA. Penelitian penggunaan topeng sains yang terhubung dengan QR Code terintegrasi *google classroom* belum pernah dilakukan.

Problem Solving adalah salah satu keterampilan yang sangat penting dalam pembelajaran (Wahyuni et al., 2017). Belajar untuk memecahkan masalah dapat diperoleh melalui tingkatan pendidikan formal karena pemahaman tentang proses *Problem Solving* masih terbatas (Nayazik, 2017). Keterampilan *Problem Solving* akan membantu peserta didik dalam menyelesaikan masalah, tidak hanya dalam kehidupan akademik tetapi di semua hal dalam kehidupan. Guru membutuhkan banyak informasi mengenai bagaimana membantu peserta didik dalam meningkatkan keterampilan *Problem Solving* agar lebih efisien. Keterampilan *Problem Solving* dapat ditingkatkan melalui pendidikan dan menjadi tujuan pembelajaran yang penting (Armağan et al., 2009).

Proses *Problem Solving* dijelaskan sebagai proses kompleks yang membutuhkan banyak kemampuan yang digunakan bersama. Unsur-unsur dari proses ini adalah memahami masalah, memilih informasi yang diperlukan, mengubah informasi yang diperoleh menjadi rancangan solusi, dan mencapai solusi setelah melakukan rancangan yang telah dibuat (Saygılı, 2017). Solusi yang dicapai melalui penguasaan proses *Problem Solving* dan menggunakan metode yang tepat tidak hanya akan menyelesaikan masalah itu saja, tetapi juga akan menjadi solusi yang lebih efektif untuk masalah serupa pada kemudian hari (Kirmizi et al., 2015).

Masalah dalam sains adalah gagasan yang penting untuk membangun kapasitas *Problem Solving* peserta didik dan menjadikan pelajaran sains lebih menyenangkan serta memotivasi peserta didik untuk berprestasi lebih baik. Kemampuan *Problem Solving* digunakan dalam memecahkan masalah sains dalam bentuk matematika dan memecahkan permasalahan atas fenomena yang terjadi di lingkungan. Namun pada kenyataannya, peserta didik mengalami kesulitan karena strategi yang diajarkan dalam pembelajaran hanya untuk menyelesaikan masalah yang memerlukan perhitungan matematis (Wahyuni et al., 2017).

Indikator kemampuan *Problem Solving* menurut Polya, sebagaimana dikutip oleh (Jayadinigrat & Ati, 2018) yaitu: (1) Memahami masalah, (2) Merencanakan penyelesaian, (3) Menyelesaikan masalah sesuai rencana, (4) Melakukan pengecekan kembali terhadap semua langkah. Peneliti telah menemukan bahwa kemampuan *Problem Solving* peserta didik dapat dilatih dan difasilitasi melalui integrasi strategi *Problem Solving* dan teknologi komputer. Kemampuan *Problem Solving* telah diakui sebagai kemampuan penting untuk beradaptasi dengan lingkungan di abad ke-21. Peran pendidikan di abad ke-21 harus mempersiapkan peserta didik untuk memenuhi tantangan dunia yang dinamis dan

saling berhubungan. Kemampuan *Problem Solving* adalah kemampuan untuk menggunakan logika untuk memecahkan masalah kehidupan nyata dan membuat keputusan (Gunawan et al., 2017).

Kemampuan pemecahan masalah merupakan kompetensi strategik agar peserta didik mampu memahami, memilih pendekatan dan strategi dalam pemecahan suatu masalah (Tanjung & Nababan, 2019). Adapun prosedur dalam pemecahan masalah adalah menemukan dan memecahkan penyebab utama dari suatu masalah. Pada kegiatan ini diperlukan kemampuan mengidentifikasi dan menganalisis penyebab dari permasalahan, menghasilkan berbagai solusi, dan menerapkannya.

Ciri-ciri peserta didik menguasai kemampuan *Problem Solving* menurut Pisaba (2018) disajikan dalam tabel berikut ini :

Tabel 1. Ciri-ciri peserta didik menguasai kemampuan *Problem Solving*

No	Indikator	Ciri – ciri
1	Memahami masalah	Keterangan yang diberikan cukup untuk mencari apa yang ditanyakan.
2	Merencanakan penyelesaian	Menemukan soal sebelumnya, memperhatikan persoalan yang ditanyakan, memikirkan apakah solusi yang digunakan untuk soal sebelumnya dapat digunakan untuk masalah ini.
3	Menyelesaikan masalah sesuai rencana	Melakukan strategi yang benar untuk menyelesaikan masalah
4	Melakukan pengecekan kembali proses dan hasil	Memeriksa kebenaran jawaban, apakah langkah yang dilakukan sesuai rencana, dan dapat digunakan untuk soal lain.

Komariah (2011) juga mengemukakan bahwa kemampuan *Problem Solving* memiliki 3 ciri utama, yaitu : (1) *Problem Solving* merupakan rangkaian aktivitas pembelajaran, artinya dalam implementasi *Problem Solving* ada sejumlah kegiatan yang harus dilakukan peserta didik. *Problem Solving* mendorong peserta didik untuk aktif berpikir, berkomunikasi, mencari dan mengolah data, dan akhirnya menyimpulkan; (2) Aktivitas pembelajaran diarahkan untuk menyelesaikan masalah. *Problem Solving* menempatkan masalah sebagai kata kunci dari proses pembelajaran. Artinya, tanpa masalah maka tidak mungkin ada proses pembelajaran; (3) Pemecahan masalah dilakukan dengan menggunakan pendekatan berpikir secara ilmiah. Berpikir dengan menggunakan metode ilmiah adalah proses berpikir deduktif dan induktif. Proses berpikir ini dilakukan secara sistematis dan empiris. Sistematis artinya berpikir ilmiah dilakukan melalui tahapan-tahapan tertentu; sedangkan empiris artinya proses penyelesaian masalah didasarkan pada data dan fakta yang jelas.

Perbedaan antara peserta didik yang memiliki kemampuan rendah (novice) dan tinggi (expert) dalam pemecahan masalah adalah bagaimana peserta didik mengorganisasi dan menggunakan pengetahuan, serta menghubungkan satu konsep dengan konsep yang lain ketika memecahkan masalah (Shih & Singh, 2013). Peserta didik yang memiliki kemampuan tinggi dalam pemecahan masalah cenderung menggunakan argumen kualitatif berdasarkan konsep yang mendasari masalah (deep feature), mengevaluasi solusi, dan cenderung menggunakan alat bantu representasi. Hal sebaliknya, peserta didik yang memiliki kemampuan rendah dalam pemecahan masalah IPA cenderung mengenali masalah berdasarkan sajian masalah (surface feature), tidak melakukan evaluasi, dan cenderung menggunakan rumus dalam memecahkan masalah (De Cock, 2012).

Kelebihan yang dimiliki oleh peserta didik apabila menguasai kemampuan pemecahan masalah yaitu (1) Dapat membuat peserta didik lebih menghayati kehidupan sehari-hari, (2) Dapat melatih dan

membiasakan peserta didik untuk menghadapi dan memecahkan masalah secara terampil, (3) Dapat mengembangkan kemampuan berfikir peserta didik secara kreatif, (4) Peserta didik sudah mulai dilatih untuk memecahkan masalahnya, (5) Peserta didik akan menunjukkan sikap aktif berfikir dan bertindak kreatif (6) Dalam kehidupan nyata peserta didik dapat memecahkan masalah yang dihadapi, (7) Peserta didik dapat mengidentifikasi dan melakukan penyelidikan (8) Dalam kegiatan pengamatan peserta didik dapat menafsirkan dan mengevaluasi hasil dari pengamatan tersebut, (9) Merangsang perkembangan kemajuan berfikir peserta didik untuk menyelesaikan masalah yang dihadapi dengan tepat, (10) Dapat membuat pendidikan sekolah lebih relevan dengan kehidupan, khususnya dunia kerja.

METODE

Penelitian ini menggunakan metode eksperimen. Metode eksperimen adalah metode penelitian yang digunakan untuk mencari pengaruh perlakuan tertentu terhadap variable yang lain dalam kondisi yang terkendali (Sugiyono, 2010). Penelitian dengan metode eksperimen ini menggunakan kelas eksperimen yang menerapkan penggunaan *Real Science Mask with QR Code* dalam kegiatan perkuliahan dan menerapkan kelas kontrol sebagai perbandingan yang menerapkan metode perkuliahan dengan media teks dalam power point. Media pembelajaran yang digunakan pada kelas eksperimen adalah *Real Science Mask with QR Code*, berupa topeng berisikan ilustrasi materi IPA yang terhubung dengan *google classroom*. *Real Science Mask with QR Code* sebagai media pembelajaran yang didesain khusus agar dapat meningkatkan literasi sains mahasiswa IPA.

Kegiatan pembelajaran menggunakan *Real Science Mask with QR Code* dilaksanakan dalam beberapa tahapan, diantaranya adalah : 1) Tahap pengenalan media, 2) Tahap pemanfaatan media *Real Science Mask with QR Code* dengan menggunakan aplikasi scanning barcode yang ada pada smartphone mahasiswa, 3) Tahap pemanfaatan platform aplikasi digital yang terhubung dengan *Real Science Mask with QR Code*, diantaranya adalah website, google classroom, dan google drive. Mahasiswa selama kegiatan pembelajaran menggunakan *Real Science Mask with QR Code* diamati aktivitas belajarnya pada kemampuan *Problem Solving* dan penguasaan literasi sains. Desain Penelitian menggunakan desain *Posttest Only Control Design*, yaitu terdapat kelas eksperimen dengan perlakuan *Real Science Mask with QR Code* dan kelas kontrol yang diberikan perlakuan media dalam power point. Variabel yang diamati ada 2 jenis, yaitu kemampuan *Problem Solving* dan keterampilan Literasi Sains. Adapun desain penelitian tergambar pada ilustrasi di bawah ini :

R ₁	X	O ₁	O ₃
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Keterangan :

R₁ : Kelas Eksperimen

R₂ : Kelas Kontrol

X : Perlakuan Media

O₁, O₂ : Kemampuan *Problem Solving*

O₃, O₄ : Kemampuan Literasi Sains

Subjek dalam penelitian ini adalah mahasiswa Program Studi Pendidikan IPA Terpadu dalam mata kuliah Biologi Dasar di Universitas Negeri Semarang (UNNES). Respon mahasiswa yang diamati adalah pada kemampuan *Problem Solving* dan Literasi Sains dengan menggunakan angket. Teknik pengumpulan data dalam penelitian ini antara lain: a) Survei awal, untuk menentukan sampel pada kelas eksperimen dan kelas kontrol. b) Pelaksanaan penelitian pada perkuliahan Biologi Dasar menggunakan media *Real Science Mask with QR Code*. c) Pengambilan data berupa nilai ujian menggunakan soal tes tertulis yang telah memenuhi kriteria pengukuran kemampuan *Problem Solving* dan literasi sains. d) Analisis Data, nilai kemampuan *Problem Solving* dan keterampilan literasi sains selanjutnya dianalisis secara deskriptif kuantitatif

HASIL DAN PEMBAHASAN

Kegiatan pembelajaran dengan memanfaatkan media *Real Science Mask with QR Code* mengajak mahasiswa untuk bersikap peduli terhadap permasalahan yang telah disajikan dalam gambar pada topeng, melalui QR Code yang tercetak dalam topeng mahasiswa diajak untuk melakukan pemindaian kode yang akan menghantarkan ke dalam aplikasi yang terkait untuk mencari solusi permasalahan yang dihadapi. Aplikasi yang terkait dalam QR Code diantaranya website, google classroom, drive. Aktivitas mahasiswa selama melaksanakan kegiatan pembelajaran diamati dari aspek kemampuan *Problem Solving* dan Keterampilan literasi sains.

Indikator kemampuan *Problem Solving* yang digunakan adalah : 1) memahami masalah. 2) merencanakan pemecahannya. 3) menyelesaikan masalah sesuai perencanaannya. 4) memeriksa kembali hasil yang diperoleh (Dewi, 2019). Dalam pengamatan aktivitas belajar mahasiswa, indikator kemampuan *Problem Solving* dijabarkan dalam beberapa aspek penilaian yang disesuaikan dengan pola kegiatan pembelajaran pada kelas eksperimen maupun pada kelas kontrol. Aspek penilaian kemampuan *Problem Solving* yang dikembangkan berdasarkan indikator tersebut diantaranya adalah : menganalisis fenomena yang sudah disajikan dalam media pembelajaran, menyusun tindak lanjut terkait dengan fenomena ilmiah, realisasi pelaksanaan sesuai dengan kaidah ilmiah, mendeskripsikan fenomena ilmiah yang dihadapi sesuai dengan fakta, melaporkan hasil pengamatan, mendiskusikan kesesuaian fenomena ilmiah dengan fakta, mampu mencari rujukan ilmiah yang terkait dengan fenomena yang dihadapi, mengkolaborasi hasil rujukan ilmiah dengan hasil analisis mandiri, mempublikasikan hasil analisis melalui media rujukan ilmiah.

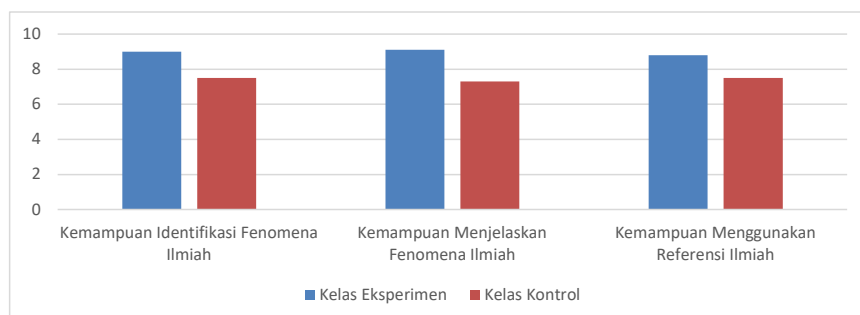
Tabel 1. Hasil Penilaian Kemampuan *Problem Solving*

Indikator	Pengembangan Aspek Penilaian	Rata – Rata Nilai	
		Kelas Eksperimen	Kelas Kontrol
Kemampuan Identifikasi Fenomena ilmiah	4. Menganalisis fenomena yang sudah disajikan dalam media pembelajaran	9,2	7,2
	5. Menyusun tindak lanjut terkait dengan fenomena ilmiah	9,0	7,5
	6. Realisasi pelaksanaan sesuai dengan kaidah ilmiah	8,8	8,0
Kemampuan Menjelaskan Fenomena Ilmiah	4. Mendeskripsikan fenomena ilmiah yang dihadapi sesuai dengan fakta	9,3	7,0
	5. Melaporkan hasil pengamatan	8,7	7,8
	6. Mendiskusikan kesesuaian fenomena ilmiah dengan fakta	9,4	7,1
Kemampuan Menggunakan Referensi Ilmiah	4. Mampu mencari rujukan ilmiah yang terkait dengan fenomena yang dihadapi	8,5	7,4
	5. Mengkolaborasi hasil rujukan ilmiah dengan hasil analisis mandiri	8,7	7,0
	6. Mempublikasikan hasil analisis melalui media rujukan ilmiah	9,1	8,0

Nilai rata-rata tertinggi pada kelas eksperimen dicapai pada aspek mendiskusikan kesesuaian fenomena ilmiah dengan fakta yang terjadi, hal tersebut membuktikan bahwa penggunaan gambar awal yang disajikan pada topeng *Real Science Mask* akan membangkitkan minat mahasiswa untuk berdiskusi. Diskusi dilakukan dengan tujuan untuk membuktikan hipotesa awal mengenai permasalahan pada gambar topeng *Real Science Mask* dengan fakta sebenarnya, dimana beberapa kebenaran tersebut sudah tersedia dalam materi di platform aplikasi lain yang terhubung pada *QR Code*, sehingga mahasiswa bisa berdiskusi dengan sesama mahasiswa, dosen berdasar pada pedoman materi belajar.

Nilai rata-rata terendah ditemukan pada kelas kontrol bagian aspek penilaian mendeskripsikan fenomena ilmiah yang sesuai dengan fakta, dan aspek penilaian mengkolaborasi hasil rujukan ilmiah dengan analisis mandiri. Kedua aspek tersebut nilainya rendah, karena pada kelas kontrol tidak menerapkan media belajar *Real Science Mask with QR Code*, sehingga mahasiswa tidak bisa mendeskripsikan permasalahan awal secara jelas dan berlanjut pada kesulitan mahasiswa untuk mengkolaborasi dengan sumber rujukan ilmiah.

Dengan demikian penggunaan media *Real Science Mask with QR Code* telah terbukti bisa meningkatkan rasa ingin tahu mahasiswa pada permasalahan yang disajikan, dan berusaha menemukan solusi dan jawaban menggunakan beberapa acuan keterampilan literasi sains yang telah dikuasainya.



Gambar 1. Perbandingan Kemampuan Problem Solving kelas Kontrol dan Eksperimen

Berdasarkan data penelitian, rata-rata nilai aspek penilaian yang tertinggi dicapai oleh indikator kemampuan menjelaskan fenomena ilmiah yang berada pada nilai 9,3. Fakta perolehan nilai tersebut menunjukkan bahwa dengan modal awal berupa gambar yang tersaji dalam *Real Science Mask with QR Code* bisa mengajak mahasiswa untuk mengasah kemampuan *Problem Solving* dengan didukung keterampilan literasi sains yang baik sehingga bisa membuka penjelasan fenomena ilmiah yang sedang dihadapi.

Kelebihan pembelajaran *Problem Solving* menurut Haryanti (2010) adalah : 1) Mendidik siswa untuk berpikir sistematis, 2) Mampu mencari jalan keluar terhadap situasi yang dihadapi, 3) Belajar menganalisis suatu masalah dari berbagai aspek, 4) Mendidik siswa percaya diri sendiri, 5) Berpikir dan bertindak kreatif, 6) Memecahkan masalah yang dihadapi secara realistis, 7) Dapat membuat perkembangan kemajuan berpikir siswa untuk menyelesaikan masalah yang dihadapi dengan tepat. Kelemahan pembelajaran *Problem Solving* : 1) Memerlukan waktu yang cukup banyak, 2) Kemampuan siswa dalam memecahkan masalah berbeda beda ada yang sempurna dalam memecahkan masalah tetapi ada juga yang kurang dalam memecahkan masalah.

Indikator keterampilan literasi sains menurut PISA diantaranya adalah : 1) Mengidentifikasi masalah ilmiah untuk penyelidikan ilmiah. 2) Menjelaskan fenomena ilmiah untuk menggambarkan atau menafsirkan fenomena ilmiah dan memberikan penjelasan. 3) Menggunakan bukti ilmiah untuk mendukung prediksi, membuat kesimpulan dan mengkomunikasikan (Bybee, 2009). Indikator keterampilan sains merupakan representasi dari setiap kegiatan ilmiah yang dilaksanakan selama kegiatan pembelajaran, sehingga disesuaikan dengan beberapa aspek penilaian sebagai dasar untuk penyusunan angket. Kegiatan pembelajaran mahasiswa yang mencerminkan indikator penilaian keterampilan Literasi Sains diukur dalam beberapa aspek penilaian berikut : mengidentifikasi isu permasalahan yang dihadapi, mengklasifikasikan jenis permasalahan, menganalisis latar belakang permasalahan, merencanakan tindakan untuk mengatasi permasalahan, melakukan tindakan nyata untuk mengatasi permasalahan, mencari sumber/rujukan ilmiah terkait dengan permasalahan, melaksanakan refleksi secara menyeluruh dari semua tindakan yang sudah dilakukan, menerima kritik dan saran terkait dengan proses yang sudah dilakukan.

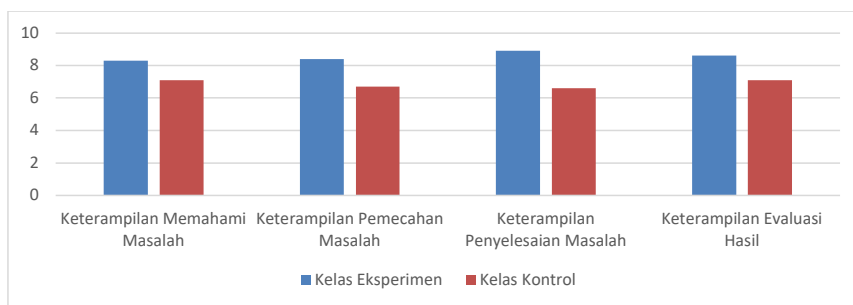
Tabel 2. Hasil Keterampilan Literasi Sains

Indikator	Pembangunan Aspek Penilaian	Rata – Rata Nilai	
		Kelas Eksperimen	Kelas Kontrol
Keterampilan Memahami Masalah	3. Mengidentifikasi isu permasalahan yang dihadapi	8,5	7,0
	4. Mengklasifikasikan jenis permasalahan	8,2	7,3
Keterampilan Pemecahan Masalah	3. Menganalisis latar belakang permasalahan	8,4	6,8
	4. Merencanakan Tindakan untuk mengatasi permasalahan	8,5	6,6

Keterampilan Penyelesaian Masalah	3. Melakukan Tindakan nyata untuk mengatasi permasalahan	9,1	6,7
	4. Mencari sumber/rujukan ilmiah terkait dengan permasalahan	8,8	6,5
Keterampilan Evaluasi Hasil	3. Melaksanakan refleksi secara menyeluruh dari semua Tindakan yang sudah dilakukan	8,7	7,0
	4. Menerima kritik dan saran terkait dengan proses yang sudah dilakukan	8,5	7,2

Pada aspek penilaian melakukan tindakan nyata untuk mengatasi permasalahan, menunjukkan rata-rata nilai yang paling tinggi yaitu 9,1. Kondisi tersebut membuktikan bahwa media *REAL SCIENCE MASK with QR Code* membuat rasa keingintahuan mahasiswa menjadi sangat besar, sehingga terpacu untuk mengembangkan keterampilan literasi sains yang dimiliki mahasiswa. Semua Tindakan nyata yang dilakukan untuk memecahkan permasalahan yang dihadapi harus memiliki pedoman secara ilmiah, bukti Tindakan ilmiah mahasiswa yang meningkat tersebut mencerminkan penguasaan kemampuan literasi sains yang baik.

Pada kelas kontrol yang tidak menerapkan media *REAL SCIENCE MASK with QR Code*, rata-rata nilai terendah berada pada aspek penilaian dalam mencari sumber/rujukan ilmiah terkait dengan permasalahan. Mahasiswa tidak mempunyai gambaran permasalahan yang jelas, sehingga keinginan untuk menemukan sebuah solusi pemecahan masalah juga sangat rendah. Dari fakta yang terjadi dalam kelas kontrol, maka bisa disimpulkan tanpa adanya masalah yang jelas, mahasiswa tidak mempunyai keinginan kuat untuk mencari sumber rujukan ilmiah.



Gambar 2. Penilaian Keterampilan Literasi Sains

Dari grafik yang menunjukkan rata-rata nilai keterampilan literasi sains yang dikuasai mahasiswa, aspek penilaian keterampilan penyelesaian masalah memperoleh rata-rata nilai yang paling tinggi sebesar 8,9. Penggunaan media *REAL SCIENCE MASK with QR Code* yang terintegrasi dengan beberapa platform aplikasi digital lainnya bisa memberikan fasilitas kepada mahasiswa untuk melakukan perencanaan dan Tindakan nyata dalam rangka untuk menemukan sebuah solusi sebagai dasar pemecahan masalah yang tengah dihadapi. Penyajian gambar di awal yang tidak memiliki keterangan tertulis membuat rasa ingin tahu mahasiswa yang semakin kuat, dilengkapi dengan adanya sebuah *QR Code* maka semakin meningkatkan keinginan mahasiswa untuk segera menemukan sebuah jawaban yang sesuai dengan gambar pada topeng *Real Science Mask*.

CONCLUSION

Kegiatan pembelajaran pada masa pandemi Covid-19 tidak diperbolehkan untuk melaksanakan kegiatan tatap muka, agar kerumunan mahasiswa yang terjadi di kelas bisa dihindari. Kegiatan pembelajaran dilaksanakan secara daring, sehingga diperlukan sebuah inovasi secara simultan agar kegiatan pembelajaran tidak cepat membosankan dan bisa mencapai tujuan belajar yang diinginkan. Topeng *Real Science Mask with QR Code* adalah sebuah inovasi pada bidang media belajar yang terintegrasi dengan beberapa platform digital youtube, drive, dan website. Hasil penelitian menunjukkan bahwa pada kemampuan *Problem Solving* aspek kemampuan menjelaskan fenomena ilmiah memiliki porsi nilai tertinggi, dan pada keterampilan literasi sains aspek keterampilan menyelesaikan masalah juga memperoleh nilai tertinggi. Kedua hasil tersebut menunjukkan bahwa *REAL SCIENCE MASK with QR Code* bisa sebagai solusi alternatif media yang bisa meningkatkan kemampuan *Problem Solving* dan keterampilan literasi sains.

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4. Hasil review tahap 2

The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy

Parts of review	Guidelines	Yes	Partly	No	Reviewer's note for improvement	Author's responds (highlight of revision)
Title	• Does the subject matter fit within the scope of journal?	√				
	• Does the title clearly and sufficiently reflect its contents?	√				
Abstract	• Does the abstract contain informative, including Background, Methods, Results and Conclusion?		√		See comments	
Back-ground	• Is the background informative and sufficient (include the background problem and objectives)?		√		The gap (and therefore needs to be investigated) has not been described. Moreover: see comments	
	• Is research question of the study clear and understandable?		√			
	• Does the rationale of the study clearly explained using relevant literature?		√			
	• Is the "aim" of the manuscript clear and understandable?	√				
Methods	• Is the methodology chosen suitable to the nature of the topic studied?		√		Effective: achieve the goal. Is the aim of this research: to improve, or to make students achieve certain criteria? No information. For the rest: see comments.	
	• Is the methodology of the research described clearly?(including study design, location, subjects, data collection, data analysis)		√		See coments	
	• Is there adequate information about the data collection tools used? (only for empirical studies)		√		Describe the instrument: based on what indicators were developed?	
	• Are the validity and reliability of data collection tools established? (only for empirical studies)		√		What is the form of the test? How many items? Is there an adapted	
	• Are the data collection tools		√			

	suitable for the methodology of the study? (only for empirical studies)			test model? How do you guarantee the validity and reliability of this test?	
Results & Discussion	<ul style="list-style-type: none"> Are the tables, graphs and pictures understandable, well presented and numbered consecutively? 		√	See comments	
	<ul style="list-style-type: none"> Do the data analysis and the interpretation appropriate to the problem and answer the objectives? 		√	Complete with: inferential analysis See comments	
	<ul style="list-style-type: none"> Does the "discussion" section of the manuscript adequately relate to the current and relevant literature? 		√	A description that relates the results to the literature and learning theory needs to be added.	
	<ul style="list-style-type: none"> Are the findings discussed adequately considering the research question(s), sub-question(s) or hypothesis? 		√	Discussion: it is necessary to link the analysis of student activity data with the results, link it with relevant learning theories, and relevant research needs to be enriched from reputable journals that are equal to or above JPPII. See comments	
Conclusion	<ul style="list-style-type: none"> Is the conclusion clear and in the form of a narration instead of pointers? 	√			
	<ul style="list-style-type: none"> Isn't the conclusion a summary and consistent between problems, objectives and conclusion? 	√			
References	<ul style="list-style-type: none"> Do the references and citations match? 	√			
	<ul style="list-style-type: none"> Are the writing of references correct? 		√	Add the latest research results, from reputable journals that are equal to and above JPPII.	
Quality Criteria	<ul style="list-style-type: none"> Do the title, problem, objectives, methods and conclusion are 		√	See our comments	

	in line? Is it well organized?				
	<ul style="list-style-type: none"> The quality of the language is satisfactory 		√		Need to be improved
	<ul style="list-style-type: none"> The work relevant and novel 		√		See our comments
	<ul style="list-style-type: none"> Are there strong consistencies among the parts of the manuscript? (introduction, methods, results and discussion, and conclusion) 		√		

The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy

DOI:

Accepted:.... Approved: Published: ...

This study aims to determine the effectiveness of Real Science Mask with QR Code on students' problem-solving skills and scientific literacy. This research is a type of experimental research that uses the Posttest Only Control Design model. The subjects of this study were students in the Integrated Science Education study program for the academic year 2020/2021 of Universitas Negeri Semarang. The sample from the population was divided into experimental class and control class. The observation instrument used an observation sheet based on the assessment indicators of students' activities during learning. Data analysis in this study used quantitative descriptive analysis, where each average value is described in each aspect of the assessment based on indicators. The results showed that the experimental class that applied the Real Science Mask with QR Code had the highest average score of Problem-Solving skills in the assessment aspect of discussing the suitability of scientific phenomena with a score of 9.4 and scientific literacy on the aspect of student assessment in seeking scientific references with a score of 8.8. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

Keywords: Real Science Mask with QR Code, Problem-solving, Scientific Literacy

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INTRODUCTION

The COVID-19 pandemic in 2020-2021 demands changes in all elements, especially in education. The usual face-to-face learning activities turn into online learning. This change requires adaptation and innovation from various parties, including teachers, lecturers, and students. It is hoped that online learning activities will form social sensitivity to the surrounding environment. The social sensitivity of students to the surrounding environment is needed to form students' caring character. Innovative online learning media are needed to facilitate the direct social interaction of students with the environment.

Competition in the 4.0 Revolution-era requires all humans to compete globally because better communication technology will open access to extensive competition from all corners of the world. Good problem-solving skills and scientific literacy are needed to compete in the current era. Problem-solving skill originates and grows from the human cognitive system, namely a process consisting of four interrelated gradual activities: identifying problems, understanding problems, solving problems, and evaluating problems. Problem-solving is a process of applying previously acquired knowledge into a new and unknown situation (Zunanda & Sinulingga, 2015). Problem-solving skill is one of the 21st-century skills that students must have. It can make students an innovative person, ready to compete in the 21st century, change the world and behavior, improve the skill to face problems, solve problems and think, analyze problems until they find solutions. A person with good problem-solving skills can be called a problem solver and is ready for all challenges in the 21st century (Rahmawati & Prasetyanti, 2019).

The concept of natural science is based on observing phenomena that occur in living things and their environment. The naked eye cannot see some things that are observed at the time of learning. Real Science Mask with QR Code is a learning media in the form of a mask containing illustrations of science material connected to Google Classroom. It is expected to facilitate learning activities to concretize an abstract science concept and not be directly observed. In addition, its use connected to Google Classrooms can provide unlimited access in the learning process to be done anywhere and anytime. Therefore, applied research is needed to develop a Real Science Mask with a QR Code which is expected to be a solution to build a concrete learning experience and improve the digital literacy of science students. The applied research proposed follows the 2016-2020 UNNES Research Strategic Plan, increasing the benefits of science and technology for the surrounding community through *Tridharma* activities. In addition, this applied research is also in line with one of the pillars of UNNES conservation, namely the pillars of value and character, because the research carried out has innovative value in learning.

Scientific literacy is defined as the skill to utilize scientific knowledge, identify questions, and draw conclusions based on real evidence to understand and make decisions regarding nature and changes made to nature through human activities (OECD, 2003). The most crucial part in developing students' scientific literacy includes science knowledge, science process, the development of scientific attitudes, and students' understanding of science so that students not only know the concept of science but also apply science skills in solving various problems and can make decisions based on scientific considerations (Yuliati, 2017).

According to Poedjiadi (Toharudin et al., 2011: 2), a person who has scientific and technological literacy is characterized by the skills to solve problems using scientific concepts obtained in education according to their level, recognizing technology products around them and their impacts, being able to use technological products and maintain them, creative in making simplified technological results so that students can make decisions based on the values and culture of society.

Research that refers to the development of both ICT-based and conventional-based learning media has been done before. Fatimah and Mufti (2014) have developed Android-based Smartphone Science-Physics Learning Media. Permana et al. (2014) have also developed Multimedia-based Science Learning Media. Mulyadi et al. (2016) have created Flipbook Flash Media. Rahman et al. (2017) have made Android-Based Augmented Reality. These studies still focus on learning outcomes only. In its development, researchers adopted the importance of problem-solving skills and scientific literacy in facing the Industrial Revolution 4.0 in education.

The study results that took the theme of problem-solving skills and scientific literacy have been conducted by several researchers, including research on problem-solving skills that can be improved by using the Thinking Aloud Pair Problem-solving learning strategy (Rahmat & Zulaikah, 2014). In addition, some studies use development that use google classroom to improve problem-solving skills (Gunawan & Suarman, 2018) but merely to develop and not analyze the effect of media usage on problem-solving skills. VanLangen et al. (2021) also conducted research measuring virtual learning skills that focus on student communication. This study looked at virtual learning skills that focused on communication skills.

The research gap analysis compared to previous research is that although it used technology and had to be carried out online. The media made could also be used offline, making it easier for students to use.

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The research aims to produce learning media in the form of Real Science Mask with QR Code that has been declared valid by experts and is appropriate in terms of readability and graphics and to obtain learning media that has been tested for its effectiveness in improving problem-solving skills and scientific literacy of science students. This research has characteristics and virtues: 1) through this research, a learning media that will be produced is Real Science Mask with QR Code, science learning is not limited by space and time and can minimize costs incurred; 2) the learning media of Real Science Mask with QR Code was designed in such a way that it can build a substantial learning experience that is interesting and easy to understand, and 3) the study results are expected to help science students to improve their problem-solving skills and scientific literacy of science students.

The applied research carried out also utilized IT-based learning media (technology). The learning media used is the Real Science Mask with QR Code, in a mask containing illustrations of science material connected to Google Classroom. It was specifically designed as a learning medium to improve problem-solving skills and scientific literacy of science students. Research on the use of science masks connected to the integrated QR Code google classroom has never been conducted.

Problem-solving is one of the essential skills in learning (Wahyuni et al., 2017). Learning to solve problems can be obtained through the level of formal education because the understanding of the process of problem-solving is still limited (Nayazik, 2017). Problem-solving skills will help students solve problems in academic life and real life. Teachers need much information about how to help students improve problem-solving skills to be more efficient. Problem-solving skills can be improved through education and become a vital learning goal (Armağan et al., 2009).

The problem-solving process is described as a complex process that requires a lot of shared skills. The elements of this process are understanding the problem, selecting the necessary information, transforming the information obtained into a solution design, and reaching a solution after carrying out the design that has been made (Saygılı, 2017). The solution achieved through mastery of the problem-solving process and using the correct method will not only solve the problem but will also be a more effective solution to similar problems in the future (Kirmizi et al., 2015).

Problems in science are essential ideas to build students' problem-solving capacities, make science lessons more fun, and motivate students to achieve more. Problem-solving skills are used in solving scientific problems in the form of mathematics and environmental phenomena. However, in reality, students experience difficulties because the strategies taught in learning are only to solve problems that require mathematical calculations (Wahyuni et al., 2017).

Indicators of problem-solving skills, according to Polya, as cited by (Jayadiningrat & Ati, 2018), are: (1) understanding the problem, (2) planning for solutions, (3) solving problems according to plan, (4) rechecking all steps. Researchers have found that students' problem-solving skills can be trained and facilitated through the integration of problem-solving strategies and computer technology. Problem-solving skill has been recognized as an essential skill to adapt to the 21-st century environment. The role of education in the 21st century must prepare students to meet the challenges of a dynamic and interconnected world. Problem-solving skills use logic to solve real-life problems and make decisions (Gunawan et al., 2017).

Problem-solving skill is a strategic competence to understand, choose approaches and strategies in solving a problem (Tanjung & Nababan, 2019). The procedure for problem-solving is to find and solve the main cause of a problem. This activity requires the skill to identify and analyze the causes of the problem, generate various solutions, and apply them.

The characteristics of students mastering the problem-solving skills, according to Pisaba (2018), are presented in the following table:

Table 1. The characteristics of students mastering the problem-solving skills

No	Indicators	Characteristics
1	Understanding the problem	The information provided is sufficient to find what is being asked.

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2 Planning a solution

Finding the previous problem, paying attention to the problem being asked, thinking about whether the solution used for the previous problem can be used for this problem.

3 Solving the problem according to plan

Solving the problem according to plan

4 Rechecking the process and results

Checking the correctness of the answer, whether the steps are according to plan, and can be used for other problems

Komarlah (2011) also argues that the problem-solving skill has three main characteristics: (1) Problem-solving is a series of learning activities, meaning that there are several activities that students must do in implementing Problem-solving. Problem-solving encourages students to actively think, communicate, find and process data, and finally conclude; (2) Learning activities are directed at solving problems. Problem-solving places the problem as the keyword of the learning process. Without problems, there will be no learning process; (3) Problem-solving is done using a scientific thinking approach. Thinking using the scientific method is a deductive and inductive thought process. This thinking process is carried out systematically and empirically. Systematic means that scientific thinking is carried out through certain stages, while empirical means that the problem-solving process is based on precise data and facts. The difference between students who have low (novice) and high (expert) skills in problem-solving is how students organize and use knowledge and connect one concept to another when solving problems (Shih & Singh, 2013). Students who have high problem-solving skills tend to use qualitative arguments based on the concepts underlying the problem (deep features), evaluate solutions, and use representational tools. On the contrary, students who have low problem-solving skills tend to recognize problems based on the problem presentation (surface feature), do not evaluate, and use formulas to solve problems (De Cock, 2012).

The advantages possessed by students when mastering problem-solving skills are: (1) It can make students live their daily lives more; (2) It can train and accustom students to face and solve problems skillfully; (3) It can develop learners' thinking skills creatively; (4) Students begin to be trained to solve the problem; (5) Students will show an active attitude to think and act creatively; (6) In real life, students can solve the problems; (7) Students can identify and carry out investigations; (8) In observing activities, students can interpret and evaluate the results of these observations; (9) It stimulates the development of the progress of students' thinking to solve the problems appropriately; (10) It can make school education more relevant to life, especially the work life.

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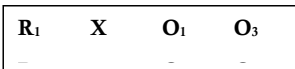
METHOD

This research used the experimental method. The experimental method is a research method used to find the effect of specific treatments on other variables in controlled conditions (Sugiyono, 2010). Research with this experimental method used an experimental class that applied Real Science Mask with QR Code in class and applied a control class as a comparison that applies the lecture method with text media in PowerPoint. Instructional media used in the classroom experimentation is Real Science Mask with QRCode, a mask containing science illustration material connected with Google Classroom. It was explicitly designed as a learning medium to improve the scientific literacy of science students.

Learning activities using Real Science Mask with QR Code were carried out in several stages, including 1) The stage of media introduction; 2) The stage of utilizing the media Real Science Mask with QR Code by using a barcode scanning application on student smartphones; 3) The stage of utilizing Digital

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or Aims

applications that are connected to the Real Science Mask with QR Code, including the website, Google Classroom, and Google Drive. During their learning activities using Real Science Mask with QR Code, their learning activities were observed on the problem-solving skill and mastery of scientific literacy. The research design used was the Posttest Only Control Design. There was an experimental class with Real Science Mask with QR Code treatment and a control class given the treatment in PowerPoint. There are two types of variables observed, problem-solving skills and scientific literacy. The research design is illustrated in the illustration below:



Description:

R1: Experimental class

R2: Control class

X: Treatment

O₁, O₂: Problem-solving skills

O₃, O₄: Scientific Literacy

Subjects in this study were students of the Integrated Science Education Study Program in the Basic Biology course at Universitas Negeri Semarang (UNNES). The students' responses observed were problem-solving skills and scientific literacy using a questionnaire. Data collection techniques in this study include a) Initial survey to determine the sample in experimental class and control class; b) Observing Basic Biology class using the media Real Science Mask with QR Code; c) Data collection in the form of test scores using written test questions that have met the criteria for measuring the problem-solving skill and scientific literacy; d) Data analysis where problem-solving skills and scientific literacy scores were analyzed descriptively quantitatively.

RESULTS AND DISCUSSION

Learning activities by utilizing the media of Real Science Mask with QR Code allow students to care about the problems presented in the image on the mask. Through the QR Code printed on the mask, students are invited to scan the code to the related application to find solutions to the problems. Applications related to the QR Code are websites, Google Classroom, and Google Drive. Student activities during learning activities were observed from the aspects of problem-solving skills and scientific literacy.

Indicators of problem-solving skills are: 1) understanding the problem; 2) planning the solution; 3) solving the problem according to the plan; 4) rechecking the results obtained (Dewi, 2019). In observing student learning activities, the skill indicator is problem-solving described in several aspects of assessment adjusted to the pattern of learning activities in the experimental class and the control class. The assessment aspects of problem-solving skills developed based on these indicators: analyzing the phenomena in the learning media, compiling follow-ups related to scientific phenomena, realizing the implementation following scientific principles, describing the scientific phenomena based on the facts, reporting the observation results, discussing the suitability of scientific phenomena with facts, finding scientific references related to the phenomena, collaborating the results of scientific references with the results of independent analysis, publishing the results of analysis through scientific reference media.

Table 2. The Assessment Results of Problem-Solving Skills

Indicators	Aspects of Assessment	The Average Score	
		Experiment class	Control class
Skill to identify scientific phenomena	7. Analyzing the phenomena in learning media	9,2	7,2
	8. Compiling follow-ups related to scientific phenomena	9,0	7,5
	9. Realizing of implementation following scientific principles	8,8	8,0
Skill to explain scientific phenomena	7. Describing the scientific phenomena based on the facts	9,3	7,0
	8. Reporting the observation results	8,7	7,8

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Commented [U31]: It is necessary to describe how the learning is carried out, including this photo of the Science-mask example in learning.

Commented [U32]: This is methods (not result) In the method, it is necessary to explain how the problem solving skills indicators are directed to science material.

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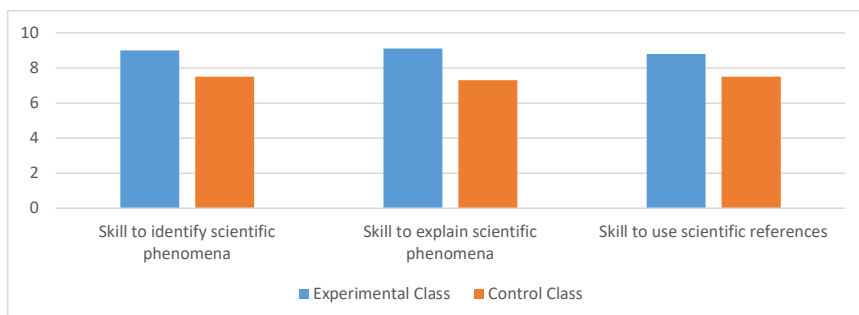
Skill to use scientific references	9. Discussing the suitability of scientific phenomena with facts	9,4	7,1
	7. Finding scientific references related to the phenomena	8,5	7,4
	8. Collaborating scientific reference results with independent analysis results	8,7	7,0
	9. Publishing the results of the analysis through scientific reference media	9,1	8,0

The highest average score in the experimental class was achieved in discussing the suitability of scientific phenomena with the facts. It proves that using the initial image presented on the Real Science Mask will arouse students' interest in the discussion. The discussion was carried out to prove the initial hypothesis regarding the problem in the mask image of Real Science Mask with facts, where some of these truths are available in the material on other application platforms that are connected to the QR Code so that students can discuss with fellow students and lecturers based on the learning material guidelines.

The lowest average score is found in the control class in describing scientific phenomena based on the facts and collaborating the scientific reference results with independent analysis results. Both of these aspects have low scores because the control class does not apply the learning media of Real Science Mask with QR Code so that students cannot describe the initial problem clearly and continue to find it difficult for students to collaborate with scientific reference sources.

Thus, Real Science Mask with QR Code has been proven to increase students' curiosity about the problems and find solutions and answers using several references to scientific literacy that they have mastered.

Figure 1. Comparison of Problem-Solving Skills in the Control class and the Experiment class



Based on research data, the highest average score was achieved by the indicator of the skill to explain scientific phenomena, which is at 9.3. With the initial thing in the form of an image in the Real Science Mask with QR Code, it can invite students to hone their problem-solving skills with the support of good scientific literacy skills to open an explanation of the scientific phenomenon.

The advantages of problem-solving learning, according to Haryanti (2010), are: 1) Educating students to think systematically; 2) Finding solutions to the situation; 3) Learning to analyze a problem from various aspects; 4) Educating students to be confident; 5) Thinking and acting creatively; 6) Solving problems realistically; 7) Making school education more relevant to life, especially the work-life; 8) Stimulating the development of progress in student thinking to solve the problems faced appropriately. Weaknesses of problem-solving learning are: 1) It takes much time; 2) Students' skill to solve different problems is different; some are perfect in solving problems, but some are not.

Indicators of scientific literacy according to PISA include: 1) Identifying scientific problems for scientific investigation; 2) Explaining scientific phenomena to describe or interpret scientific phenomena and provide explanations; 3) Using scientific evidence to support predictions, make conclusions and communicate (Bybee, 2009). Science skill indicators represent every scientific activity carried out during

learning activities so that they are adjusted to several aspects of assessment as a basis for the preparation of a questionnaire. Student learning activities that reflect the indicators of the assessment of scientific literacy are measured in the following aspects of the assessment: identifying the problems, classifying types of problems, analyzing background problems, planning actions to solve problems, taking real action to solve problems, looking for scientific sources/references related to the problem, carrying out a thorough reflection of all taken actions, receiving criticism and suggestions related to the process.

Table 3. The Assessment Results of Scientific Literacy

Indicators	Aspects of Assessment	The Average Score	
		Experiment Class	Control Class
Problem-Understanding Skills	5. Identifying the problems	8,5	7,0
	6. Classifying the types of problems	8,2	7,3
Problem-Solving Skills 1	5. Analyzing the background of the problem	8,4	6,8
	6. Plannin actions to solve problems	8,5	6,6
Problem-Solving Skills 2	5. Taking real action to solve the problem	9,1	6,7
	6. Looking for scientific sources/references related to the problem	8,8	6,5
Results-Evaluation Skills	5. Carrying out a thorough reflection of all taken actions	8,7	7,0
	6. Receiving criticism and suggestions related to the process	8,5	7,2

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The highest average score was in taking real action to solve the problem, which is at 9.1. This condition proved that the media of Real Science Mask with QR Code made students' curiosity very big so that they are motivated to develop their scientific literacy skills. All concrete actions taken to solve the problems faced must have scientific guidelines, and it reflects the mastery of good scientific literacy skills. In the control class that does not apply the media of Real Science Mask with QR Code, the lowest average score was finding scientific sources/references related to the problem. Students do not have a clear picture of the problem, so the desire to find a problem-solving solution is also deficient. From the facts that occurred in the control class, it can be concluded that without any apparent problems, students do not have a strong desire to look for scientific reference sources.

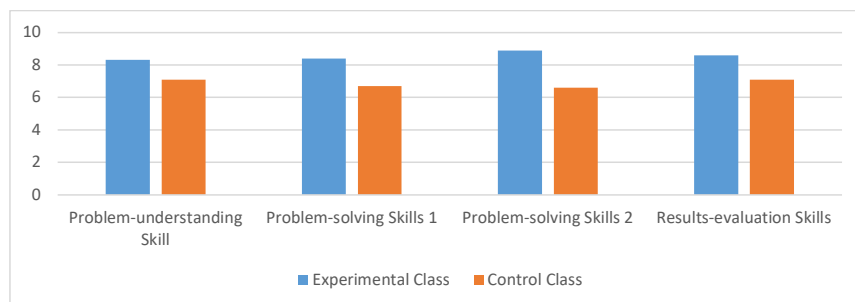


Figure 2. The Assessment of Scientific Literacy

The figure shows the average score of scientific literacy skills mastered by students. Problem-solving skills 2 obtained the highest average score of 8.9. Real Science Mask with QR Code integrated with several other digital application platforms can provide facilities for students to carry out planning and real action to find a solution to solve the problems. The presentation of the image initially that does not have a written description makes students' curiosity stronger. Equipped with a QR Code, it will further increase students' desire to immediately find an answer to the image on the Real Science Mask.

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CONCLUSION

Face-to-face learning activities during the COVID-19 pandemic are not allowed to avoid crowds of students in class. Learning activities are carried out online. Hence, simultaneous innovation is needed so that learning activities do not get boring and can achieve the learning goals. The Real Science Mask with QR Code is an innovation in learning media integrated with multiple digital platforms, such as YouTube, G-drive, and website. The results showed that the problem-solving skills in the skill to explain scientific phenomena had the highest score, and in scientific literacy, the problem-solving skills 2 also received the highest score. These two results indicate that Real Science Mask with QR Code can be an alternative media solution that can improve the problem-solving skills and scientific literacy of students.

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Commented [U35]: Discuss:

how are the results related to the learning implementation data (link them to relevant theories and research)
Discuss unique results/data (eg, what problem solving aspect results/data stands out the most? why is that?)

Data literacy aspects on what competencies stand out? (of 3 or 4 aspects of competence)? Why?

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5. Mengirim revisi 2

The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy**DOI:**

Accepted:... . Approved: Published: ...

This study aims to determine the effectiveness of Real Science Mask with QR Code on students' problem-solving skills and scientific literacy. This research is a type of experimental research that uses the Pretest Posttest Control Group Design model. The subjects of this study were students in the Integrated Science Education study program for the academic year 2020/2021 of Universitas Negeri Semarang. The sample from the population was divided into experimental class and control class. The observation instrument used an observation sheet based on the assessment indicators of students' activities during learning. Data analysis in this study used quantitative descriptive analysis, where each average value is described in each aspect of the assessment based on indicators. The results showed that the experimental class that applied the Real Science Mask with QR Code had the highest average score of Problem-Solving skills in the assessment aspect of discussing the suitability of scientific phenomena with a score of 9.4 and scientific literacy on the aspect of student assessment in seeking scientific references with a score of 8.8. The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

Keywords: Real Science Mask with QR Code, Problem-solving, Scientific Literacy

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INTRODUCTION

The COVID-19 pandemic in 2020-2021 demands changes in all elements, especially in education. The usual face-to-face learning activities turn into online learning. This change requires adaptation and innovation from various parties, including teachers, lecturers, and students. It is hoped that online learning activities will form social sensitivity to the surrounding environment. The social sensitivity of students to the surrounding environment is needed to form students' caring character (Purwanti, 2017). Innovative online learning media are needed to facilitate the direct social interaction of students with the environment.

Competition in the 4.0 Revolution-era requires all humans to compete globally because better communication technology will open access to extensive competition from all corners of the world. In the tight challenges faced society, a paradigm shift is needed in the education system that can provide 21st century skill set required by students to deal with every aspect global life (Soh et al., 2010). Good problem-solving skills and scientific literacy are needed to compete in the current era. Problem-solving skill originates and grows from the human cognitive system, namely a process consisting of four interrelated gradual activities: identifying problems, understanding problems, solving problems, and evaluating problems. Problem-solving is a process of applying previously acquired knowledge into a new and unknown situation (Zunanda & Sinulingga, 2015). Problem-solving skill is one of the 21st-century skills that students must have. It can make students an innovative person, ready to compete in the 21st century, change the world and behavior, improve the skill to face problems, solve problems and think, analyze problems until they find solutions. A person with good problem-solving skills can be called a problem solver and is ready for all challenges in the 21st century (Rahmawati & Prasetyanti, 2019). In an attempt solve the problem at hand, an individual will take steps associated with cognitive processes. Research conducted by Guilford et al (Patnani, 2013), concludes that several cognitive functions are involved in problem solving problem :

1. Think quickly about the characteristics of an object or situation
2. Classification of objects or ideas
3. Forming or compiling relationships between objects or ideas
4. Think about the various possible outcomes
5. List the characteristics of the goals and come up with a logical solution.

The concept of natural science is based on observing phenomena that occur in living things and their environment. IPA not only mastery of the knowledge pool in the form of facts, concepts, or principles only but also is a process of discovery. Science lessons are a means for students to learn on their own and the surrounding nature, as well

as prospects further development in apply it in daily life (Mulyasa, 2010). The normal eyes without science abilities cannot see some things that are observed at the time of learning.

Learning without using interesting science media, students will get bored easily. Real Science Mask can help students overcome boredom, because it uses interesting characters. Real Science Mask with QR Code is a learning media in the form of a mask containing illustrations of science material connected to Google Classroom. It is expected to facilitate learning activities to concretize an abstract science concept and not be directly observed. In addition, its use connected to Google Classrooms can provide unlimited access in the learning process to be done anywhere and anytime. Therefore, applied research is needed to develop a Real Science Mask with a QR Code which is expected to be a solution to build a concrete learning experience and improve the digital literacy of science students.

Science literacy defined as skill use scientific knowledge, identify questions, and attract conclusions based on evidence, in order to understand and make decisions relating to nature and the changes that carried out on nature through activities done by humans (Utama et al., 2019). The most crucial part in developing students' scientific literacy includes science knowledge, science process, the development of scientific attitudes, and students' understanding of science so that students not only know the concept of science but also apply science skills in solving various problems and can make decisions based on scientific considerations

According to Poedjiadi (Toharudin et al., 2011: 2), a person who has scientific and technological literacy is characterized by the skills to solve problems using scientific concepts obtained in education according to their level, recognizing technology products around them and their impacts, being able to use technological products and maintain them, creative in making simplified technological results so that students can make decisions based on the values and culture of society.

Research that refers to the development of both ICT-based and conventional-based learning media has been done before. Fatimah and Mufti (2014) have developed Android-based Smartphone Science-Physics Learning Media. Permana et al. (2014) have also developed Multimedia-based Science Learning Media. Mulyadi et al. (2016) have created Flipbook Flash Media. Rahman et al. (2017) have made Android-Based Augmented Reality. These studies still focus on learning outcomes only. In its development, researchers adopted the importance of problem-solving skills and scientific literacy in facing the Industrial Revolution 4.0 in education.

The study results that took the theme of problem-solving skills and scientific literacy have

been conducted by several researchers, including research on problem-solving skills that can be improved by using the Thinking Aloud Pair Problem-solving learning strategy (Rahmat & Zulaikah, 2014). In addition, some studies use development that use google classroom to improve problem-solving skills (Gunawan & Suarman, 2018) but merely to develop and not analyze the effect of media usage on problem-solving skills. VanLangen et al. (2021) also conducted research measuring virtual learning skills that focus on student communication. This study looked at virtual learning skills that focused on communication skills.

The research gap analysis compared to previous research is that although it used technology and had to be carried out online. The media made could also be used offline, making it easier for students to use. This condition can be a solution for students who find it difficult to use complex equipment to study. The research aims to produce learning media in the form of Real Science Mask with QR Code that has been declared valid by experts and is appropriate in terms of readability and graphics and to obtain learning media that has been tested for its effectiveness in improving problem-solving skills and scientific literacy of science students. This research has characteristics and virtues: 1) through this research, a learning media that will be produced is Real Science Mask with QR Code, science learning is not limited by space and time and can minimize costs incurred; 2) the learning media of Real Science Mask with QR Code was designed in such a way that it can build a substantial learning experience that is interesting and easy to understand, and 3) the study results are expected to help science students to improve their problem-solving skills and scientific literacy of science students.

The applied research carried out also utilized IT-based learning media (technology). The learning media used is the Real Science Mask with QR Code, in a mask containing illustrations of science material connected to Google Classroom. It was specifically designed as a learning medium to improve problem-solving skills and scientific literacy of science students. Research on the use of science masks connected to the integrated QR Code google classroom has never been conducted.

Problem-solving is one of the essential skills in learning (Wahyuni et al., 2017). Learning to solve problems can be obtained through the level of formal education because the understanding of the process of problem-solving is still limited (Nayazik, 2017). Problem-solving skills will help students solve problems in academic life and real life. Teachers need much information about how to help students improve problem-solving skills to be more efficient. Ability to decipher and summarize information for solving problems is often called with analytical-synthetic capabilities, and can be upgraded using problem solving method (Fahrina et al., 2018). The

problem-solving process is described as a complex process that requires a lot of shared skills. The elements of this process are understanding the problem, selecting the necessary information, transforming the information obtained into a solution design, and reaching a solution after carrying out the design that has been made (Saygılı, 2017). The solution achieved through mastery of the problem-solving process and using the correct method will not only solve the problem but will also be a more effective solution to similar problems in the future (Kirmizi et al., 2015).

Problems in science are essential ideas to build students' problem-solving capacities, make science lessons more fun, and motivate students to achieve more. Problem-solving skills are used in solving scientific problems in the form of mathematics and environmental phenomena. However, in reality, students experience difficulties because the strategies taught in learning are only to solve problems that require mathematical calculations (Wahyuni et al., 2017).

Indicators of problem-solving skills, according to Polya, as cited by (Jayadiningrat & Ati, 2018), are: (1) understanding the problem, (2) planning for solutions, (3) solving problems according to plan, (4) rechecking all steps. Researchers have found that students' problem-solving skills can be trained and facilitated through the integration of problem-solving strategies and computer technology. Problem-solving skill has been recognized as an essential skill to adapt to the 21-st century environment. The role of education in the 21st century must prepare students to meet the challenges of a dynamic and interconnected world. Problem-solving skills use logic to solve real-life problems and make decisions (Gunawan et al., 2017).

Problem-solving skill is a strategic competence to understand, choose approaches and strategies in solving a problem (Tanjung & Nababan, 2019). The procedure for problem-solving is to find and solve the main cause of a problem. This activity requires the skill to identify and analyze the causes of the problem, generate various solutions, and apply them.

The characteristics of students mastering the problem-solving skills in science also agree according to Pisaba (2018), are presented in the following table:

Table 1. The characteristics of students mastering the problem-solving skills

No	Indicators	Characteristics
1	Understanding the problem	The information provided is sufficient to find what is being asked.

- | | | |
|---|---------------------------------------|--|
| 2 | Planning a solution | Finding the previous problem, paying attention to the problem being asked, thinking about whether the solution used for the previous problem can be used for this problem. |
| 3 | Solving the problem according to plan | Solving the problem according to plan |
| 4 | Rechecking the process and results | Checking the correctness of the answer, whether the steps are according to plan, and can be used for other problems |

Komariah (2011) also argues that the problem-solving skill has three main characteristics: (1) Problem-solving is a series of learning activities, meaning that there are several activities that students must do in implementing Problem-solving. Problem-solving encourages students to actively think, communicate, find and process data, and finally conclude; (2) Learning activities are directed at solving problems. Problem-solving places the problem as the keyword of the learning process. Without problems, there will be no learning process; (3) Problem-solving is done using a scientific thinking approach. Thinking using the scientific method is a deductive and inductive thought process. This thinking process is carried out systematically and empirically. Systematic means that scientific thinking is carried out through certain stages, while empirical means that the problem-solving process is based on precise data and facts.

The difference between students who have low (novice) and high (expert) skills in problem-solving is how students organize and use knowledge and connect one concept to another when solving problems (Shih & Singh, 2013). Students who have high problem-solving skills tend to use qualitative arguments based on the concepts underlying the problem (deep features), evaluate solutions, and use representational tools. On the contrary, students who have low problem-solving skills tend to recognize problems based on the problem presentation (surface feature), do not evaluate, and use formulas to solve problems (De Cock, 2012).

The advantages possessed by students when mastering problem-solving skills are: (1) It can make students live their daily lives more; (2) It can train and accustom students to face and solve problems skillfully; (3) It can develop learners' thinking skills creatively; (4) Students begin to be

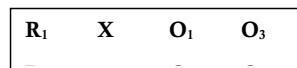
trained to solve the problem; (5) Students will show an active attitude to think and act creatively; (6) In real life, students can solve the problems; (7) Students can identify and carry out investigations; (8) In observing activities, students can interpret and evaluate the results of these observations; (9) It stimulates the development of the progress of students' thinking to solve the problems appropriately; (10) It can make school education more relevant to life, especially the work life.

The purpose of this research to overcome the problem of student boredom in learning science and aims to determine the effectiveness Real Science Mask.

METHOD

This research used the experimental method. The experimental method is a research method used to find the effect of specific treatments on other variables in controlled conditions (Sugiyono, 2010). Research with this experimental method used an experimental class that applied Real Science Mask with QR Code in class and applied a control class as a comparison that applies the lecture method with text media in PowerPoint. Instructional media used in the classroom experimentation is Real Science Mask with QR Code, a mask containing science illustration material connected with Google Classroom. It was explicitly designed as a learning medium to improve the scientific literacy of science students.

Learning activities using Real Science Mask with QR Code were carried out in several stages, including 1) The stage of media introduction; 2) The stage of utilizing the media Real Science Mask with QR Code by using a barcode scanning application on student smartphones; 3) The stage of utilizing Digital applications that are connected to the Real Science Mask with QR Code, including the website, Google Classroom, and Google Drive. During their learning activities using Real Science Mask with QR Code, their learning activities were observed on the problem-solving skill and mastery of scientific literacy. The research design used was the Posttest Only Control Design. There was an experimental class with Real Science Mask with QR Code treatment and a control class given the treatment in PowerPoint. There are two types of variables observed, problem-solving skills and scientific literacy. The research design is illustrated in the illustration below:



Description:

R1: Experimental class

R2: Control class

X: Treatment

O₁, O₂: Problem-solving skills

O₃, O₄: Scientific Literacy

The research sample was obtained by simple random sampling method. simple random sampling technique is a technique of taking samples from members of the population which is carried out randomly without regard to the strata that exist in the population (Sugiyono, 2010).

Subjects in this study were students of the Integrated Science Education Study Program in the Basic Biology course at Universitas Negeri Semarang (UNNES). The students' responses observed were problem-solving skills and scientific literacy using a test. Data collection techniques in this study include a) Initial survey to determine the sample in experimental class and control class using a previous score; b) Observing Basic Biology class using the media Real Science Mask with QR Code; c) Data collection in the form of test scores using written test questions that have met the criteria for measuring the problem-solving skill and scientific literacy; d) Data analysis where problem-solving skills and scientific literacy scores were analyzed descriptively quantitatively and then analyzed using inferential analysis independent sample t-test.

RESULTS AND DISCUSSION

Learning activities by utilizing the media of Real Science Mask with QR Code allow students to care about the problems presented in the image on the mask. Through the QR Code printed on the mask, students are invited to scan the code to the related application to find solutions

to the problems. Applications related to the QR Code are websites, Google Classroom, and Google Drive. Student activities during learning activities were observed from the aspects of problem-solving skills and scientific literacy.

In observing student learning activities, the skill indicator is problem-solving described in several aspects of assessment adjusted to the pattern of learning activities in the experimental class and the control class. The assessment aspects of problem-solving skills developed based on these indicators: analyzing the phenomena in the learning media, compiling follow-ups related to scientific phenomena, realizing the implementation following scientific principles, describing the scientific phenomena based on the facts, reporting the observation results, discussing the suitability of scientific phenomena with facts, finding scientific references related to the phenomena, collaborating the results of scientific references with the results of independent analysis, publishing the results of analysis through scientific reference media. Indicators of problem-solving skills are: 1) understanding the problem; 2) planning the solution; 3) solving the problem according to the plan; 4) rechecking the results obtained (Dewi & Septa, 2019).

The development of a problem-solving test uses basic indicators of problem-solving abilities that are aligned with the basic biology course material. Each indicator is described in accordance with the basic competencies listed in the semester learning plan. Based on the consideration of problem solving indicators, student learning activities and learning materials, specific testing instruments can be developed.

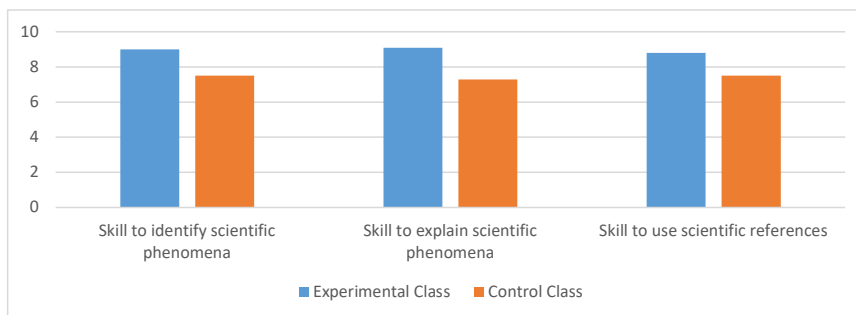
Table 2. The Assessment Results of Problem-Solving Skills

Indicators	Aspects of Assessment	The Average Score	
		Experiment class	Control class
Skill to identify scientific phenomena	10. Analyzing the phenomena in learning media	9,2	7,2
	11. Compiling follow-ups related to scientific phenomena	9,0	7,5
	12. Realizing of implementation following scientific principles	8,8	8,0
Skill to explain scientific phenomena	10. Describing the scientific phenomena based on the facts	9,3	7,0
	11. Reporting the observation results	8,7	7,8
	12. Discussing the suitability of scientific phenomena with facts	9,4	7,1
Skill to use scientific references	10. Finding scientific references related to the phenomena	8,5	7,4
	11. Collaborating scientific reference results with independent analysis results	8,7	7,0
	12. Publishing the results of the analysis through scientific reference media	9,1	8,0

The highest average score in the experimental class was achieved in discussing the suitability of scientific phenomena with the facts. It proves that using the initial image presented on the Real Science Mask will arouse students' interest in the discussion. The discussion was carried out to prove the initial hypothesis regarding the problem in the mask image of Real Science Mask with facts, where some of these truths are available in the material on other application platforms that are connected to the QR Code so that students can discuss with fellow students and lecturers based on the learning material guidelines.

The lowest average score is found in the control class in describing scientific phenomena

Figure 1. Comparison of Problem-Solving Skills in the Control class and the Experiment class



Based on research data, the highest average score was achieved by the indicator of the skill to explain scientific phenomena, which is at 9.3. With the initial thing in the form of an image in the Real Science Mask with QR Code, it can invite students to hone their problem-solving skills with the support of good scientific literacy skills to open an explanation of the scientific phenomenon.

The advantages of problem-solving learning, according to Haryanti (2010), are: 1) Educating students to think systematically; 2) Finding solutions to the situation; 3) Learning to analyze a problem from various aspects; 4) Educating students to be confident; 5) Thinking and acting creatively; 6) Solving problems realistically; 7) Making school education more relevant to life, especially the work-life; 8) Stimulating the development of progress in student thinking to solve the problems faced appropriately. Weaknesses of problem-solving learning are: 1) It takes much time; 2) Students' skill to solve different problems is different; some are perfect in solving problems, but some are not.

based on the facts and collaborating the scientific reference results with independent analysis results. Both of these aspects have low scores because the control class does not apply the learning media of Real Science Mask with QR Code so that students cannot describe the initial problem clearly and continue to find it difficult for students to collaborate with scientific reference sources.

Thus, Real Science Mask with QR Code has been proven to increase students' curiosity about the problems and find solutions and answers using several references to scientific literacy that they have mastered.

Indicators of scientific literacy according to PISA include: 1) Identifying scientific problems for scientific investigation; 2) Explaining scientific phenomena to describe or interpret scientific phenomena and provide explanations; 3) Using scientific evidence to support predictions, make conclusions and communicate (Bybee, 2009). Science skill indicators represent every scientific activity carried out during learning activities so that they are adjusted to several aspects of assessment as a basis for the preparation of a questionnaire. Student learning activities that reflect the indicators of the assessment of scientific literacy are measured in the following aspects of the assessment: identifying the problems, classifying types of problems, analyzing background problems, planning actions to solve problems, taking real action to solve problems, looking for scientific sources/references related to the problem, carrying out a thorough reflection of all taken actions, receiving criticism and suggestions related to the process.

Table 3. The Assessment Results of Scientific Literacy

Indicators	Aspects of Assessment	The Average Score	
		Experiment Class	Control Class
Problem-Understanding Skills	7. Identifying the problems	8,5	7,0
	8. Classifying the types of problems	8,2	7,3

Problem-Solving Skills 1	7. Analyzing the background of the problem	8,4	6,8
	8. Plannin actions to solve problems	8,5	6,6
Problem-Solving Skills 2	7. Taking real action to solve the problem	9,1	6,7
	8. Looking for scientific sources/references related to the problem	8,8	6,5
Results-Evaluation Skills	7. Carrying out a thorough reflection of all taken actions	8,7	7,0
	8. Receiving criticism and suggestions related to the process	8,5	7,2

The highest average score was in taking real action to solve the problem, which is at 9.1. This condition proved that the media of Real Science Mask with QR Code made students' curiosity very big so that they are motivated to develop their scientific literacy skills. All concrete actions taken to solve the problems faced must have scientific guidelines, and it reflects the mastery of good scientific literacy skills.

In the control class that does not apply the media of Real Science Mask with QR Code, the lowest average score was finding scientific sources/references related to the problem. Students do not have a clear picture of the problem, so the desire to find a problem-solving solution is also deficient. From the facts that occurred in the control class, it can be concluded that without any apparent problems, students do not have a strong desire to look for scientific reference sources.

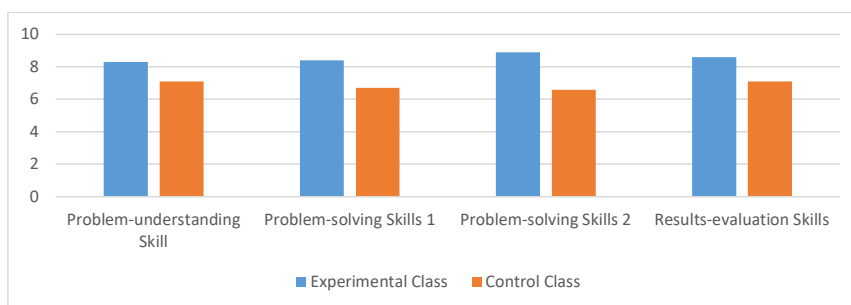


Figure 2. The Assessment of Scientific Literacy

The figure shows the average score of scientific literacy skills mastered by students. Problem-solving skills 2 obtained the highest average score of 8.9. Real Science Mask with QR Code integrated with several other digital application platforms can provide facilities for students to

carry out planning and real action to find a solution to solve the problems. The presentation of the image initially that does not have a written description makes students' curiosity stronger. Equipped with a QR Code, it will further increase students' desire to immediately find an answer to the image on the Real Science Mask.

Table 4. Independent t-test result

		Levene's Test for Equality of Variances		t-test for Equality of Means		95% Confidence Interval of the Difference				
		F	Sig.	t	df	Sig. (2-tailed)	(2-Mean Difference)	Std. Error Difference	Lower	Upper
nilai	Equal variances assumed	1.005	.331	8.951	16	.000	15.222	1.701	11.617	18.827
	Equal variances not assumed			8.951	14.913	.000	15.222	1.701	11.596	18.849

The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

The unique phenomenon found during the implementation of this research is in problem solving skills, especially aspects of explaining scientific phenomena, because with the use of Real Science Mask media, students become highly curious after observing the images presented on the masks. Scientific evidence that has been obtained from various reliable sources is then interpreted and reduced by students who direct students to problem solutions (Asyhari, 2015). To find answers to problems and explain scientific phenomena well, students try to find scientific evidence to strengthen the opinions expressed.

CONCLUSION

Face-to-face learning activities during the COVID-19 pandemic are not allowed to avoid crowds of students in class. Learning activities are carried out online. Hence, simultaneous innovation is needed so that learning activities do not get boring and can achieve the learning goals. The Real Science Mask with QR Code is an innovation in learning media integrated with multiple digital platforms, such as YouTube, G-drive, and website. The results showed that the problem-solving skills in the skill to explain scientific phenomena had the highest score, and in scientific literacy, the problem-solving skills 2 also received the highest score. These two results indicate that Real Science Mask with QR Code can be an alternative media solution that can improve the problem-solving skills and scientific literacy of students.

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63-70.

6. Hasil review 3

The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy

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This study aims to determine the effectiveness of Real Science Mask with QR Code on students' problem-solving skills and scientific literacy. This research is a type of experimental research that uses the Pretest Posttest Control Group Design model. The subjects of this study were students in the Integrated Science Education study program for the academic year 2020/2021 of Universitas Negeri Semarang. The sample from the population was divided into experimental class and control class. The observation instrument used an observation sheet based on the assessment indicators of students' activities during learning. Data analysis in this study used quantitative descriptive analysis, where each average value is described in each aspect of the assessment based on indicators. The results showed that the experimental class that applied the Real Science Mask with QR Code had the highest average score of Problem-Solving skills in the assessment aspect of discussing the suitability of scientific phenomena with a score of 9.4 and scientific literacy on the aspect of student assessment in seeking scientific references with a score of 8.8. The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

Keywords: Real Science Mask with QR Code, Problem-solving, Scientific Literacy

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INTRODUCTION

The COVID-19 pandemic in 2020-2021 demands changes in all elements, especially in education. The usual face-to-face learning activities turn into online learning. This change requires adaptation and innovation from various parties, including teachers, lecturers, and students. It is hoped that online learning activities will form social sensitivity to the surrounding environment. The social sensitivity of students to the surrounding environment is needed to form students' caring character (Purwanti, 2017). Innovative online learning media are needed to facilitate the direct social interaction of students with the environment.

Competition in the 4.0 Revolution-era requires all humans to compete globally because better communication technology will open access to extensive competition from all corners of the world. In the tight challenges faced society, a paradigm shift is needed in the education system that can provide 21st century skill set required by students to deal with every aspect global life (Soh et al., 2010). Good problem-solving skills and scientific literacy are needed to compete in the current era. Problem-solving skill originates and grows from the human cognitive system, namely a process consisting of four interrelated gradual activities: identifying problems, understanding problems, solving problems, and evaluating problems. Problem-solving is a process of applying previously acquired knowledge into a new and unknown situation (Zunanda & Sinulingga, 2015). Problem-solving skill is one of the 21st-century skills that students must have. It can make students an innovative person, ready to compete in the 21st century, change the world and behavior, improve the skill to face problems, solve problems and think, analyze problems until they find solutions. A person with good problem-solving skills can be called a problem solver and is ready for all challenges in the 21st century (Rahmawati & Prasetyanti, 2019). In an attempt solve the problem at hand, an individual will take steps associated with cognitive processes. Research conducted by Guilford et al (Patnani, 2013), concludes that several cognitive functions are involved in problem solving problem :

1. Think quickly about the characteristics of an object or situation
2. Classification of objects or ideas
3. Forming or compiling relationships between objects or ideas
4. Think about the various possible outcomes
5. List the characteristics of the goals and come up with a logical solution.

The concept of natural science is based on observing phenomena that occur in living things and their environment. IPA not only mastery of the knowledge pool in the form of facts, concepts, or principles only but also is a process of discovery. Science lessons are a means for students to learn on their own and the surrounding nature, as well

as prospects further development in apply it in daily life (Mulyasa, 2010). The normal eyes without science abilities cannot see some things that are observed at the time of learning.

Learning without using interesting science media, students will get bored easily. Real Science Mask can help students overcome boredom, because it uses interesting characters. Real Science Mask with QR Code is a learning media in the form of a mask containing illustrations of science material connected to Google Classroom. It is expected to facilitate learning activities to concretize an abstract science concept and not be directly observed. In addition, its use connected to Google Classrooms can provide unlimited access in the learning process to be done anywhere and anytime. Therefore, applied research is needed to develop a Real Science Mask with a QR Code which is expected to be a solution to build a concrete learning experience and improve the digital literacy of science students.

Science literacy defined as skill use scientific knowledge, identify questions, and attract conclusions based on evidence, in order to understand and make decisions relating to nature and the changes that carried out on nature through activities done by humans (Utama et al., 2019). The most crucial part in developing students' scientific literacy includes science knowledge, science process, the development of scientific attitudes, and students' understanding of science so that students not only know the concept of science but also apply science skills in solving various problems and can make decisions based on scientific considerations

According to Poedjiadi (Toharudin et al., 2011: 2), a person who has scientific and technological literacy is characterized by the skills to solve problems using scientific concepts obtained in education according to their level, recognizing technology products around them and their impacts, being able to use technological products and maintain them, creative in making simplified technological results so that students can make decisions based on the values and culture of society.

Research that refers to the development of both ICT-based and conventional-based learning media has been done before. Fatimah and Mufti (2014) have developed Android-based Smartphone Science-Physics Learning Media. Permana et al. (2014) have also developed Multimedia-based Science Learning Media. Mulyadi et al. (2016) have created Flipbook Flash Media. Rahman et al. (2017) have made Android-Based Augmented Reality. These studies still focus on learning outcomes only. In its development, researchers adopted the importance of problem-solving skills and scientific literacy in facing the Industrial Revolution 4.0 in education.

The study results that took the theme of problem-solving skills and scientific literacy have

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been conducted by several researchers, including research on problem-solving skills that can be improved by using the Thinking Aloud Pair Problem-solving learning strategy (Rahmat & Zulaikah, 2014). In addition, some studies use development that use google classroom to improve problem-solving skills (Gunawan & Suarman, 2018) but merely to develop and not analyze the effect of media usage on problem-solving skills. VanLangen et al. (2021) also conducted research measuring virtual learning skills that focus on student communication. This study looked at virtual learning skills that focused on communication skills.

The research gap analysis compared to previous research is that although it used technology and had to be carried out online. The media made could also be used offline, making it easier for students to use. This condition can be a solution for students who find it difficult to use complex equipment to study. The research aims to produce learning media in the form of Real Science Mask with QR Code that has been declared valid by experts and is appropriate in terms of readability and graphics and to obtain learning media that has been tested for its effectiveness in improving problem-solving skills and scientific literacy of science students. This research has characteristics and virtues: 1) through this research, a learning media that will be produced is Real Science Mask with QR Code, science learning is not limited by space and time and can minimize costs incurred; 2) the learning media of Real Science Mask with QR Code was designed in such a way that it can build a substantial learning experience that is interesting and easy to understand, and 3) the study results are expected to help science students to improve their problem-solving skills and scientific literacy of science students.

The applied research carried out also utilized IT-based learning media (technology). The learning media used is the Real Science Mask with QR Code, in a mask containing illustrations of science material connected to Google Classroom. It was specifically designed as a learning medium to improve problem-solving skills and scientific literacy of science students. Research on the use of science masks connected to the integrated QR Code google classroom has never been conducted.

Problem-solving is one of the essential skills in learning (Wahyuni et al., 2017). Learning to solve problems can be obtained through the level of formal education because the understanding of the process of problem-solving is still limited (Nayazik, 2017). Problem-solving skills will help students solve problems in academic life and real life. Teachers need much information about how to help students improve problem-solving skills to be more efficient. Ability to decipher and summarize information for solving problems is often called with analytical-synthetic capabilities, and can be upgraded using problem solving method (Fahrina et al., 2018). The

problem-solving process is described as a complex process that requires a lot of shared skills. The elements of this process are understanding the problem, selecting the necessary information, transforming the information obtained into a solution design, and reaching a solution after carrying out the design that has been made (Saygılı, 2017). The solution achieved through mastery of the problem-solving process and using the correct method will not only solve the problem but will also be a more effective solution to similar problems in the future (Kirmizi et al., 2015).

Problems in science are essential ideas to build students' problem-solving capacities, make science lessons more fun, and motivate students to achieve more. Problem-solving skills are used in solving scientific problems in the form of mathematics and environmental phenomena. However, in reality, students experience difficulties because the strategies taught in learning are only to solve problems that require mathematical calculations (Wahyuni et al., 2017).

Indicators of problem-solving skills, according to Polya, as cited by (Jayadiningrat & Ati, 2018), are: (1) understanding the problem, (2) planning for solutions, (3) solving problems according to plan, (4) rechecking all steps. Researchers have found that students' problem-solving skills can be trained and facilitated through the integration of problem-solving strategies and computer technology. Problem-solving skill has been recognized as an essential skill to adapt to the 21-st century environment. The role of education in the 21st century must prepare students to meet the challenges of a dynamic and interconnected world. Problem-solving skills use logic to solve real-life problems and make decisions (Gunawan et al., 2017).

Problem-solving skill is a strategic competence to understand, choose approaches and strategies in solving a problem (Tanjung & Nababan, 2019). The procedure for problem-solving is to find and solve the main cause of a problem. This activity requires the skill to identify and analyze the causes of the problem, generate various solutions, and apply them.

The characteristics of students mastering the problem-solving skills in science also agree according to Pisaba (2018), are presented in the following table:

Table 1. The characteristics of students mastering the problem-solving skills

No	Indicators	Characteristics
1	Understanding the problem	The information provided is sufficient to find what is being asked.

- | | | |
|---|---------------------------------------|--|
| 2 | Planning a solution | Finding the previous problem, paying attention to the problem being asked, thinking about whether the solution used for the previous problem can be used for this problem. |
| 3 | Solving the problem according to plan | Solving the problem according to plan |
| 4 | Rechecking the process and results | Checking the correctness of the answer, whether the steps are according to plan, and can be used for other problems |

Komariah (2011) also argues that the problem-solving skill has three main characteristics: (1) Problem-solving is a series of learning activities, meaning that there are several activities that students must do in implementing Problem-solving. Problem-solving encourages students to actively think, communicate, find and process data, and finally conclude; (2) Learning activities are directed at solving problems. Problem-solving places the problem as the keyword of the learning process. Without problems, there will be no learning process; (3) Problem-solving is done using a scientific thinking approach. Thinking using the scientific method is a deductive and inductive thought process. This thinking process is carried out systematically and empirically. Systematic means that scientific thinking is carried out through certain stages, while empirical means that the problem-solving process is based on precise data and facts.

The difference between students who have low (novice) and high (expert) skills in problem-solving is how students organize and use knowledge and connect one concept to another when solving problems (Shih & Singh, 2013). Students who have high problem-solving skills tend to use qualitative arguments based on the concepts underlying the problem (deep features), evaluate solutions, and use representational tools. On the contrary, students who have low problem-solving skills tend to recognize problems based on the problem presentation (surface feature), do not evaluate, and use formulas to solve problems (De Cock, 2012).

The advantages possessed by students when mastering problem-solving skills are: (1) It can make students live their daily lives more; (2) It can train and accustom students to face and solve problems skillfully; (3) It can develop learners' thinking skills creatively; (4) Students begin to be

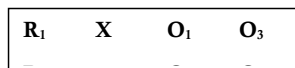
trained to solve the problem; (5) Students will show an active attitude to think and act creatively; (6) In real life, students can solve the problems; (7) Students can identify and carry out investigations; (8) In observing activities, students can interpret and evaluate the results of these observations; (9) It stimulates the development of the progress of students' thinking to solve the problems appropriately; (10) It can make school education more relevant to life, especially the work life.

The purpose of this research to overcome the problem of student boredom in learning science and aims to determine the effectiveness Real Science Mask.

METHOD

This research used the experimental method. The experimental method is a research method used to find the effect of specific treatments on other variables in controlled conditions (Sugiyono, 2010). Research with this experimental method used an experimental class that applied Real Science Mask with QR Code in class and applied a control class as a comparison that applies the lecture method with text media in PowerPoint. Instructional media used in the classroom experimentation is Real Science Mask with QR Code, a mask containing science illustration material connected with Google Classroom. It was explicitly designed as a learning medium to improve the scientific literacy of science students.

Learning activities using Real Science Mask with QR Code were carried out in several stages, including 1) The stage of media introduction; 2) The stage of utilizing the media Real Science Mask with QR Code by using a barcode scanning application on student smartphones; 3) The stage of utilizing Digital applications that are connected to the Real Science Mask with QR Code, including the website, Google Classroom, and Google Drive. During their learning activities using Real Science Mask with QR Code, their learning activities were observed on the problem-solving skill and mastery of scientific literacy. The research design used was the Posttest Only Control Design. There was an experimental class with Real Science Mask with QR Code treatment and a control class given the treatment in PowerPoint. There are two types of variables observed, problem-solving skills and scientific literacy. The research design is illustrated in the illustration below:



Description:
 R1: Experimental class
 R2: Control class
 X: Treatment
 O₁, O₂: Problem-solving skills
 O₃, O₄: Scientific Literacy

The research sample was obtained by simple random sampling method. simple random sampling technique is a technique of taking samples from members of the population which is carried out randomly without regard to the strata that exist in the population (Sugiyono, 2010).

Subjects in this study were students of the Integrated Science Education Study Program in the Basic Biology course at Universitas Negeri Semarang (UNNES). The students' responses observed were problem-solving skills and scientific literacy using a test. Data collection techniques in this study include a) Initial survey to determine the sample in experimental class and control class using a previous score; b) Observing Basic Biology class using the media Real Science Mask with QR Code; c) Data collection in the form of test scores using written test questions that have met the criteria for measuring the problem-solving skill and scientific literacy; d) Data analysis where problem-solving skills and scientific literacy scores were analyzed descriptively quantitatively and then analyzed using inferential analysis independent sample t-test.

RESULTS AND DISCUSSION

Learning activities by utilizing the media of Real Science Mask with QR Code allow students to care about the problems presented in the image on the mask. Through the QR Code printed on the mask, students are invited to scan the code to the related application to find solutions

to the problems. Applications related to the QR Code are websites, Google Classroom, and Google Drive. Student activities during learning activities were observed from the aspects of problem-solving skills and scientific literacy.

In observing student learning activities, the skill indicator is problem-solving described in several aspects of assessment adjusted to the pattern of learning activities in the experimental class and the control class. The assessment aspects of problem-solving skills developed based on these indicators: analyzing the phenomena in the learning media, compiling follow-ups related to scientific phenomena, realizing the implementation following scientific principles, describing the scientific phenomena based on the facts, reporting the observation results, discussing the suitability of scientific phenomena with facts, finding scientific references related to the phenomena, collaborating the results of scientific references with the results of independent analysis, publishing the results of analysis through scientific reference media. Indicators of problem-solving skills are: 1) understanding the problem; 2) planning the solution; 3) solving the problem according to the plan; 4) rechecking the results obtained (Dewi & Septa, 2019).

The development of a problem-solving test uses basic indicators of problem-solving abilities that are aligned with the basic biology course material. Each indicator is described in accordance with the basic competencies listed in the semester learning plan. Based on the consideration of problem solving indicators, student learning activities and learning materials, specific testing instruments can be developed.

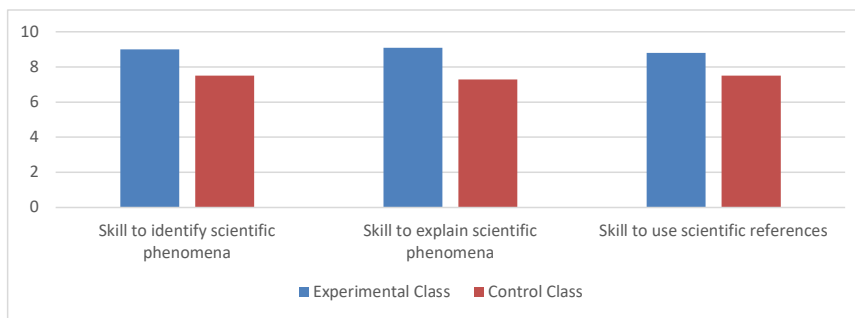
Table 2. The Assessment Results of Problem-Solving Skills

Indicators	Aspects of Assessment	The Average Score	
		Experiment class	Control class
Skill to identify scientific phenomena	13. Analyzing the phenomena in learning media	9,2	7,2
	14. Compiling follow-ups related to scientific phenomena	9,0	7,5
	15. Realizing of implementation following scientific principles	8,8	8,0
Skill to explain scientific phenomena	13. Describing the scientific phenomena based on the facts	9,3	7,0
	14. Reporting the observation results	8,7	7,8
	15. Discussing the suitability of scientific phenomena with facts	9,4	7,1
Skill to use scientific references	13. Finding scientific references related to the phenomena	8,5	7,4
	14. Collaborating scientific reference results with independent analysis results	8,7	7,0
	15. Publishing the results of the analysis through scientific reference media	9,1	8,0

The highest average score in the experimental class was achieved in discussing the suitability of scientific phenomena with the facts. It proves that using the initial image presented on the Real Science Mask will arouse students' interest in the discussion. The discussion was carried out to prove the initial hypothesis regarding the problem in the mask image of Real Science Mask with facts, where some of these truths are available in the material on other application platforms that are connected to the QR Code so that students can discuss with fellow students and lecturers based on the learning material guidelines.

The lowest average score is found in the control class in describing scientific phenomena

Figure 1. Comparison of Problem-Solving Skills in the Control class and the Experiment class



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Based on research data, the highest average score was achieved by the indicator of the skill to explain scientific phenomena, which is at 9.3. With the initial thing in the form of an image in the Real Science Mask with QR Code, it can invite students to hone their problem-solving skills with the support of good scientific literacy skills to open an explanation of the scientific phenomenon.

The advantages of problem-solving learning, according to Haryanti (2010), are: 1) Educating students to think systematically; 2) Finding solutions to the situation; 3) Learning to analyze a problem from various aspects; 4) Educating students to be confident; 5) Thinking and acting creatively; 6) Solving problems realistically; 7) Making school education more relevant to life, especially the work-life; 8) Stimulating the development of progress in student thinking to solve the problems faced appropriately. Weaknesses of problem-solving learning are: 1) It takes much time; 2) Students' skill to solve different problems is different; some are perfect in solving problems, but some are not.

based on the facts and collaborating the scientific reference results with independent analysis results. Both of these aspects have low scores because the control class does not apply the learning media of Real Science Mask with QR Code so that students cannot describe the initial problem clearly and continue to find it difficult for students to collaborate with scientific reference sources.

Thus, Real Science Mask with QR Code has been proven to increase students' curiosity about the problems and find solutions and answers using several references to scientific literacy that they have mastered.

Indicators of scientific literacy according to PISA include: 1) Identifying scientific problems for scientific investigation; 2) Explaining scientific phenomena to describe or interpret scientific phenomena and provide explanations; 3) Using scientific evidence to support predictions, make conclusions and communicate (Bybee, 2009). Science skill indicators represent every scientific activity carried out during learning activities so that they are adjusted to several aspects of assessment as a basis for the preparation of a questionnaire. Student learning activities that reflect the indicators of the assessment of scientific literacy are measured in the following aspects of the assessment: identifying the problems, classifying types of problems, analyzing background problems, planning actions to solve problems, taking real action to solve problems, looking for scientific sources/references related to the problem, carrying out a thorough reflection of all taken actions, receiving criticism and suggestions related to the process.

Table 3. The Assessment Results of Scientific Literacy

Indicators	Aspects of Assessment	The Average Score	
		Experiment Class	Control Class
Problem-Understanding Skills	9. Identifying the problems	8,5	7,0
	10. Classifying the types of problems	8,2	7,3

Problem-Solving Skills 1	9. Analyzing the background of the problem	8,4	6,8
	10. Plannin actions to solve problems	8,5	6,6
Problem-Solving Skills 2	9. Taking real action to solve the problem	9,1	6,7
	10. Looking for scientific sources/references related to the problem	8,8	6,5
Results-Evaluation Skills	9. Carrying out a thorough reflection of all taken actions	8,7	7,0
	10. Receiving criticism and suggestions related to the process	8,5	7,2

The highest average score was in taking real action to solve the problem, which is at 9.1. This condition proved that the media of Real Science Mask with QR Code made students' curiosity very big so that they are motivated to develop their scientific literacy skills. All concrete actions taken to solve the problems faced must have scientific guidelines, and it reflects the mastery of good scientific literacy skills.

In the control class that does not apply the media of Real Science Mask with QR Code, the lowest average score was finding scientific sources/references related to the problem. Students do not have a clear picture of the problem, so the desire to find a problem-solving solution is also deficient. From the facts that occurred in the control class, it can be concluded that without any apparent problems, students do not have a strong desire to look for scientific reference sources.

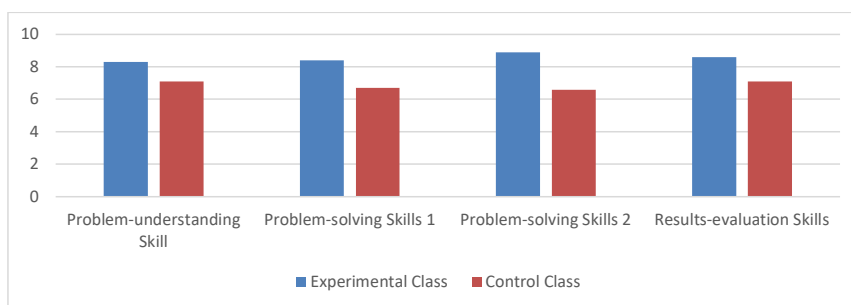


Figure 2. The Assessment of Scientific Literacy

The figure shows the average score of scientific literacy skills mastered by students. Problem-solving skills 2 obtained the highest average score of 8.9. Real Science Mask with QR Code integrated with several other digital application platforms can provide facilities for students to

carry out planning and real action to find a solution to solve the problems. The presentation of the image initially that does not have a written description makes students' curiosity stronger. Equipped with a QR Code, it will further increase students' desire to immediately find an answer to the image on the Real Science Mask.

Table 4. Independent t-test result

		Levene's Test for Equality of Variances		t-test for Equality of Means		95% Confidence Interval of the Difference				
		F	Sig.	t	df	Sig. (2-tailed)	(2-Mean Difference)	Std. Error Difference	Lower	Upper
nilai	Equal variances assumed	1.005	.331	8.951	16	.000	15.222	1.701	11.617	18.827
	Equal variances not assumed			8.951	14.913	.000	15.222	1.701	11.596	18.849

The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

The unique phenomenon found during the implementation of this research is in problem solving skills, especially aspects of explaining scientific phenomena, because with the use of Real Science Mask media, students become highly curious after observing the images presented on the masks. Scientific evidence that has been obtained from various reliable sources is then interpreted and reduced by students who direct students to problem solutions (Asyhari, 2015). To find answers to problems and explain scientific phenomena well, students try to find scientific evidence to strengthen the opinions expressed.

CONCLUSION

Face-to-face learning activities during the COVID-19 pandemic are not allowed to avoid crowds of students in class. Learning activities are carried out online. Hence, simultaneous innovation is needed so that learning activities do not get boring and can achieve the learning goals. The Real Science Mask with QR Code is an innovation in learning media integrated with multiple digital platforms, such as YouTube, G-drive, and website. The results showed that the problem-solving skills in the skill to explain scientific phenomena had the highest score, and in scientific literacy, the problem-solving skills 2 also received the highest score. These two results indicate that Real Science Mask with QR Code can be an alternative media solution that can improve the problem-solving skills and scientific literacy of students.

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7. Mengirim revisi 3

The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy

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This study aims to determine the effectiveness of Real Science Mask with QR Code on students' problem-solving skills and scientific literacy. This research is a type of experimental research that uses the Pretest Posttest Control Group Design model. The subjects of this study were students in the Integrated Science Education study program for the academic year 2020/2021 of Universitas Negeri Semarang. The sample from the population was divided into experimental class and control class. The observation instrument used an observation sheet based on the assessment indicators of students' activities during learning. Data analysis in this study used quantitative descriptive analysis, where each average value is described in each aspect of the assessment based on indicators. The results showed that the experimental class that applied the Real Science Mask with QR Code had the highest average score of Problem-Solving skills in the assessment aspect of discussing the suitability of scientific phenomena with a score of 9.4 and scientific literacy on the aspect of student assessment in seeking scientific references with a score of 8.8. The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

Keywords: Real Science Mask with QR Code, Problem-solving, Scientific Literacy

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INTRODUCTION

The COVID-19 pandemic in 2020-2021 demands changes in all elements, especially in education. The usual face-to-face learning activities turn into online learning. This change requires adaptation and innovation from various parties, including teachers, lecturers, and students. It is hoped that online learning activities will form social sensitivity to the surrounding environment. The social sensitivity of students to the surrounding environment is needed to form students' caring character (Purwanti, 2017). Innovative online learning media are needed to facilitate the direct social interaction of students with the environment.

Competition in the 4.0 Revolution-era requires all humans to compete globally because better communication technology will open access to extensive competition from all corners of the world. In the tight challenges faced society, a paradigm shift is needed in the education system that can provide 21st century skill set required by students to deal with every aspect global life (Soh et al., 2010). Good problem-solving skills and scientific literacy are needed to compete in the current era. Problem-solving skill originates and grows from the human cognitive system, namely a process consisting of four interrelated gradual activities: identifying problems, understanding problems, solving problems, and evaluating problems. Problem-solving is a process of applying previously acquired knowledge into a new and unknown situation (Zunanda & Sinulingga, 2015). Problem-solving skill is one of the 21st-century skills that students must have. It can make students an innovative person, ready to compete in the 21st century, change the world and behavior, improve the skill to face problems, solve problems and think, analyze problems until they find solutions. A person with good problem-solving skills can be called a problem solver and is ready for all challenges in the 21st century (Rahmawati & Prasetyanti, 2019). In an attempt solve the problem at hand, an individual will take steps associated with cognitive processes. Research conducted by Guilford et al (Patnani, 2013), concludes that several cognitive functions are involved in problem solving problem :

1. Think quickly about the characteristics of an object or situation
2. Classification of objects or ideas
3. Forming or compiling relationships between objects or ideas
4. Think about the various possible outcomes
5. List the characteristics of the goals and come up with a logical solution.

The concept of natural science is based on observing phenomena that occur in living things and their environment. IPA not only mastery of the knowledge pool in the form of facts, concepts, or principles only but also is a process of discovery. Science lessons are a means for students to learn on their own and the surrounding nature, as well

as prospects further development in apply it in daily life (Mulyasa, 2010). The normal eyes without science abilities cannot see some things that are observed at the time of learning.

Learning without using interesting science media, students will get bored easily. Real Science Mask can help students overcome boredom, because it uses interesting characters. Real Science Mask with QR Code is a learning media in the form of a mask containing illustrations of science material connected to Google Classroom. It is expected to facilitate learning activities to concretize an abstract science concept and not be directly observed. In addition, its use connected to Google Classrooms can provide unlimited access in the learning process to be done anywhere and anytime. Therefore, applied research is needed to develop a Real Science Mask with a QR Code which is expected to be a solution to build a concrete learning experience and improve the digital literacy of science students.

Science literacy defined as skill use scientific knowledge, identify questions, and attract conclusions based on evidence, in order to understand and make decisions relating to nature and the changes that carried out on nature through activities done by humans (Utama et al., 2019). The most crucial part in developing students' scientific literacy includes science knowledge, science process, the development of scientific attitudes, and students' understanding of science so that students not only know the concept of science but also apply science skills in solving various problems and can make decisions based on scientific considerations

According to Poedjiadi (Toharudin et al., 2011: 2), a person who has scientific and technological literacy is characterized by the skills to solve problems using scientific concepts obtained in education according to their level, recognizing technology products around them and their impacts, being able to use technological products and maintain them, creative in making simplified technological results so that students can make decisions based on the values and culture of society.

Research that refers to the development of both ICT-based and conventional-based learning media has been done before. Fatimah and Mufti (2014) have developed Android-based Smartphone Science-Physics Learning Media. Permana & Damiri (2014) have also developed Multimedia-based Science Learning Media. Mulyadi & Wahyuni (2016) have created Flipbook Flash Media. Rahman et al. (2017) have made Android-Based Augmented Reality. These studies still focus on learning outcomes only. In its development, researchers adopted the importance of problem-solving skills and scientific literacy in facing the Industrial Revolution 4.0 in education.

The study results that took the theme of problem-solving skills and scientific literacy have

been conducted by several researchers, including research on problem-solving skills that can be improved by using the Thinking Aloud Pair Problem-solving learning strategy (Rahmat & Zulaikah, 2014). In addition, some studies use development that use google classroom to improve problem-solving skills (Gunawan & Suarman, 2018) but merely to develop and not analyze the effect of media usage on problem-solving skills. VanLangen et al. (2021) also conducted research measuring virtual learning skills that focus on student communication. This study looked at virtual learning skills that focused on communication skills.

The research gap analysis compared to previous research is that although it used technology and had to be carried out online. The media made could also be used offline, making it easier for students to use. This condition can be a solution for students who find it difficult to use complex equipment to study. The research aims to produce learning media in the form of Real Science Mask with QR Code that has been declared valid by experts and is appropriate in terms of readability and graphics and to obtain learning media that has been tested for its effectiveness in improving problem-solving skills and scientific literacy of science students. This research has characteristics and virtues: 1) through this research, a learning media that will be produced is Real Science Mask with QR Code, science learning is not limited by space and time and can minimize costs incurred; 2) the learning media of Real Science Mask with QR Code was designed in such a way that it can build a substantial learning experience that is interesting and easy to understand, and 3) the study results are expected to help science students to improve their problem-solving skills and scientific literacy of science students.

The applied research carried out also utilized IT-based learning media (technology). The learning media used is the Real Science Mask with QR Code, in a mask containing illustrations of science material connected to Google Classroom. It was specifically designed as a learning medium to improve problem-solving skills and scientific literacy of science students. Research on the use of science masks connected to the integrated QR Code google classroom has never been conducted.

Problem-solving is one of the essential skills in learning (Wahyuni et al., 2017). Learning to solve problems can be obtained through the level of formal education because the understanding of the process of problem-solving is still limited (Nayazik, 2017). Problem-solving skills will help students solve problems in academic life and real life. Teachers need much information about how to help students improve problem-solving skills to be more efficient. Ability to decipher and summarize information for solving problems is often called with analytical-synthetic capabilities, and can be upgraded using problem solving method (Fahrina et al., 2018). The

problem-solving process is described as a complex process that requires a lot of shared skills. The elements of this process are understanding the problem, selecting the necessary information, transforming the information obtained into a solution design, and reaching a solution after carrying out the design that has been made (Saygılı, 2017). The solution achieved through mastery of the problem-solving process and using the correct method will not only solve the problem but will also be a more effective solution to similar problems in the future (Kirmizi et al., 2015).

Problems in science are essential ideas to build students' problem-solving capacities, make science lessons more fun, and motivate students to achieve more. Problem-solving skills are used in solving scientific problems in the form of mathematics and environmental phenomena. However, in reality, students experience difficulties because the strategies taught in learning are only to solve problems that require mathematical calculations (Wahyuni et al., 2017).

Indicators of problem-solving skills, according to Polya, as cited by (Jayadiningrat & Ati, 2018), are: (1) understanding the problem, (2) planning for solutions, (3) solving problems according to plan, (4) rechecking all steps. Researchers have found that students' problem-solving skills can be trained and facilitated through the integration of problem-solving strategies and computer technology. Problem-solving skill has been recognized as an essential skill to adapt to the 21-st century environment. The role of education in the 21st century must prepare students to meet the challenges of a dynamic and interconnected world. Problem-solving skills use logic to solve real-life problems and make decisions (Gunawan et al., 2017).

Problem-solving skill is a strategic competence to understand, choose approaches and strategies in solving a problem (Tanjung & Nababan, 2019). The procedure for problem-solving is to find and solve the main cause of a problem. This activity requires the skill to identify and analyze the causes of the problem, generate various solutions, and apply them.

The characteristics of students mastering the problem-solving skills in science also agree according to Pisaba (2018), are presented in the following table:

Table 1. The characteristics of students mastering the problem-solving skills

No	Indicators	Characteristics
1	Understanding the problem	The information provided is sufficient to find what is being asked.

- | | | |
|---|---------------------------------------|--|
| 2 | Planning a solution | Finding the previous problem, paying attention to the problem being asked, thinking about whether the solution used for the previous problem can be used for this problem. |
| 3 | Solving the problem according to plan | Solving the problem according to plan |
| 4 | Rechecking the process and results | Checking the correctness of the answer, whether the steps are according to plan, and can be used for other problems |

Komariah (2011) also argues that the problem-solving skill has three main characteristics: (1) Problem-solving is a series of learning activities, meaning that there are several activities that students must do in implementing Problem-solving. Problem-solving encourages students to actively think, communicate, find and process data, and finally conclude; (2) Learning activities are directed at solving problems. Problem-solving places the problem as the keyword of the learning process. Without problems, there will be no learning process; (3) Problem-solving is done using a scientific thinking approach. Thinking using the scientific method is a deductive and inductive thought process. This thinking process is carried out systematically and empirically. Systematic means that scientific thinking is carried out through certain stages, while empirical means that the problem-solving process is based on precise data and facts.

The difference between students who have low (novice) and high (expert) skills in problem-solving is how students organize and use knowledge and connect one concept to another when solving problems (Shih & Singh, 2013). Students who have high problem-solving skills tend to use qualitative arguments based on the concepts underlying the problem (deep features), evaluate solutions, and use representational tools. On the contrary, students who have low problem-solving skills tend to recognize problems based on the problem presentation (surface feature), do not evaluate, and use formulas to solve problems (De Cock, 2012).

The advantages possessed by students when mastering problem-solving skills are: (1) It can make students live their daily lives more; (2) It can train and accustom students to face and solve problems skillfully; (3) It can develop learners' thinking skills creatively; (4) Students begin to be

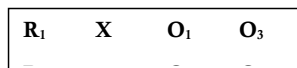
trained to solve the problem; (5) Students will show an active attitude to think and act creatively; (6) In real life, students can solve the problems; (7) Students can identify and carry out investigations; (8) In observing activities, students can interpret and evaluate the results of these observations; (9) It stimulates the development of the progress of students' thinking to solve the problems appropriately; (10) It can make school education more relevant to life, especially the work life.

The purpose of this research to overcome the problem of student boredom in learning science and aims to determine the effectiveness Real Science Mask.

METHOD

This research used the experimental method. The experimental method is a research method used to find the effect of specific treatments on other variables in controlled conditions (Sugiyono, 2010). Research with this experimental method used an experimental class that applied Real Science Mask with QR Code in class and applied a control class as a comparison that applies the lecture method with text media in PowerPoint. Instructional media used in the classroom experimentation is Real Science Mask with QRCode, a mask containing science illustration material connected with Google Classroom. It was explicitly designed as a learning medium to improve the scientific literacy of science students.

Learning activities using Real Science Mask with QR Code were carried out in several stages, including 1) The stage of media introduction; 2) The stage of utilizing the media Real Science Mask with QR Code by using a barcode scanning application on student smartphones; 3) The stage of utilizing Digital applications that are connected to the Real Science Mask with QR Code, including the website, Google Classroom, and Google Drive. During their learning activities using Real Science Mask with QR Code, their learning activities were observed on the problem-solving skill and mastery of scientific literacy. The research design used was the Posttest Only Control Design. There was an experimental class with Real Science Mask with QR Code treatment and a control class given the treatment in PowerPoint. There are two types of variables observed, problem-solving skills and scientific literacy. The research design is illustrated in the illustration below:



Description:
 R1: Experimental class
 R2: Control class
 X: Treatment
 O₁, O₂: Problem-solving skills
 O₃, O₄: Scientific Literacy

The research sample was obtained by simple random sampling method. simple random sampling technique is a technique of taking samples from members of the population which is carried out randomly without regard to the strata that exist in the population (Sugiyono, 2010).

Subjects in this study were students of the Integrated Science Education Study Program in the Basic Biology course at Universitas Negeri Semarang (UNNES). The students' responses observed were problem-solving skills and scientific literacy using a test. Data collection techniques in this study include a) Initial survey to determine the sample in experimental class and control class using a previous score; b) Observing Basic Biology class using the media Real Science Mask with QR Code; c) Data collection in the form of test scores using written test questions that have met the criteria for measuring the problem-solving skill and scientific literacy; d) Data analysis where problem-solving skills and scientific literacy scores were analyzed descriptively quantitatively and then analyzed using inferential analysis independent sample t-test.

RESULTS AND DISCUSSION

Learning activities by utilizing the media of Real Science Mask with QR Code allow students to care about the problems presented in the image on the mask. Through the QR Code printed on the mask, students are invited to scan the code to the related application to find solutions

to the problems. Applications related to the QR Code are websites, Google Classroom, and Google Drive. Student activities during learning activities were observed from the aspects of problem-solving skills and scientific literacy.

In observing student learning activities, the skill indicator is problem-solving described in several aspects of assessment adjusted to the pattern of learning activities in the experimental class and the control class. The assessment aspects of problem-solving skills developed based on these indicators: analyzing the phenomena in the learning media, compiling follow-ups related to scientific phenomena, realizing the implementation following scientific principles, describing the scientific phenomena based on the facts, reporting the observation results, discussing the suitability of scientific phenomena with facts, finding scientific references related to the phenomena, collaborating the results of scientific references with the results of independent analysis, publishing the results of analysis through scientific reference media. Indicators of problem-solving skills are: 1) understanding the problem; 2) planning the solution; 3) solving the problem according to the plan; 4) rechecking the results obtained (Dewi & Septa, 2019).

The development of a problem-solving test uses basic indicators of problem-solving abilities that are aligned with the basic biology course material. Each indicator is described in accordance with the basic competencies listed in the semester learning plan. Based on the consideration of problem solving indicators, student learning activities and learning materials, specific testing instruments can be developed.

Table 2. The Assessment Results of Problem-Solving Skills

Indicators	Aspects of Assessment	The Average Score	
		Experiment class	Control class
Skill to identify scientific phenomena	16. Analyzing the phenomena in learning media	9,2	7,2
	17. Compiling follow-ups related to scientific phenomena	9,0	7,5
	18. Realizing of implementation following scientific principles	8,8	8,0
Skill to explain scientific phenomena	16. Describing the scientific phenomena based on the facts	9,3	7,0
	17. Reporting the observation results	8,7	7,8
	18. Discussing the suitability of scientific phenomena with facts	9,4	7,1
Skill to use scientific references	16. Finding scientific references related to the phenomena	8,5	7,4
	17. Collaborating scientific reference results with independent analysis results	8,7	7,0
	18. Publishing the results of the analysis through scientific reference media	9,1	8,0

The highest average score in the experimental class was achieved in discussing the suitability of scientific phenomena with the facts. It proves that using the initial image presented on the Real Science Mask will arouse students' interest in the discussion. The discussion was carried out to prove the initial hypothesis regarding the problem in the mask image of Real Science Mask with facts, where some of these truths are available in the material on other application platforms that are connected to the QR Code so that students can discuss with fellow students and lecturers based on the learning material guidelines.

The lowest average score is found in the control class in describing scientific phenomena

based on the facts and collaborating the scientific reference results with independent analysis results. Both of these aspects have low scores because the control class does not apply the learning media of Real Science Mask with QR Code so that students cannot describe the initial problem clearly and continue to find it difficult for students to collaborate with scientific reference sources.

Thus, Real Science Mask with QR Code has been proven to increase students' curiosity about the problems and find solutions and answers using several references to scientific literacy that they have mastered.

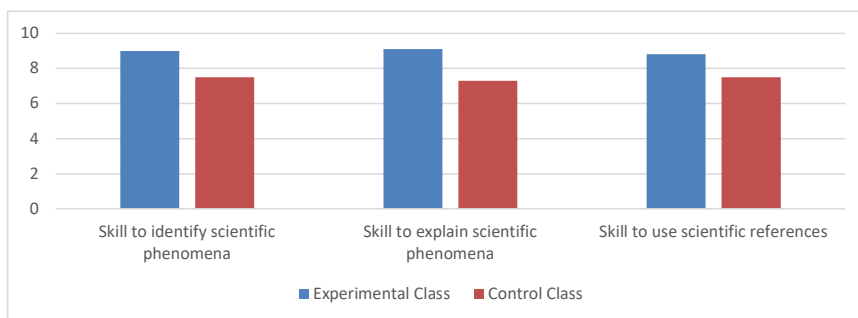


Figure 1. Comparison of Problem-Solving Skills in the Control class and the Experiment class

Based on research data, the highest average score was achieved by the indicator of the skill to explain scientific phenomena, which is at 9.3. With the initial thing in the form of an image in the Real Science Mask with QR Code, it can invite students to hone their problem-solving skills with the support of good scientific literacy skills to open an explanation of the scientific phenomenon.

The advantages of problem-solving learning, according to Haryanti (2010), are: 1) Educating students to think systematically; 2) Finding solutions to the situation; 3) Learning to analyze a problem from various aspects; 4) Educating students to be confident; 5) Thinking and acting creatively; 6) Solving problems realistically; 7) Making school education more relevant to life, especially the work-life; 8) Stimulating the development of progress in student thinking to solve the problems faced appropriately. Weaknesses of problem-solving learning are: 1) It takes much time; 2) Students' skill to solve different problems is different; some are perfect in solving problems, but some are not.

Indicators of scientific literacy according to PISA include: 1) Identifying scientific problems for scientific investigation; 2) Explaining scientific phenomena to describe or interpret scientific phenomena and provide explanations; 3) Using scientific evidence to support predictions, make conclusions and communicate (Bybee, 2009). Science skill indicators represent every scientific activity carried out during learning activities so that they are adjusted to several aspects of assessment as a basis for the preparation of a questionnaire. Student learning activities that reflect the indicators of the assessment of scientific literacy are measured in the following aspects of the assessment: identifying the problems, classifying types of problems, analyzing background problems, planning actions to solve problems, taking real action to solve problems, looking for scientific sources/references related to the problem, carrying out a thorough reflection of all taken actions, receiving criticism and suggestions related to the process.

Table 3. The Assessment Results of Scientific Literacy

Indicators	Aspects of Assessment	The Average Score	
		Experiment Class	Control Class
Problem-Understanding Skills	11. Identifying the problems	8,5	7,0
	12. Classifying the types of problems	8,2	7,3

Problem-Solving Skills 1	11. Analyzing the background of the problem	8,4	6,8
	12. Plannin actions to solve problems	8,5	6,6
Problem-Solving Skills 2	11. Taking real action to solve the problem	9,1	6,7
	12. Looking for scientific sources/references related to the problem	8,8	6,5
Results-Evaluation Skills	11. Carrying out a thorough reflection of all taken actions	8,7	7,0
	12. Receiving criticism and suggestions related to the process	8,5	7,2

The highest average score was in taking real action to solve the problem, which is at 9.1. This condition proved that the media of Real Science Mask with QR Code made students' curiosity very big so that they are motivated to develop their scientific literacy skills. All concrete actions taken to solve the problems faced must have scientific guidelines, and it reflects the mastery of good scientific literacy skills.

In the control class that does not apply the media of Real Science Mask with QR Code, the lowest average score was finding scientific sources/references related to the problem. Students do not have a clear picture of the problem, so the desire to find a problem-solving solution is also deficient. From the facts that occurred in the control class, it can be concluded that without any apparent problems, students do not have a strong desire to look for scientific reference sources.

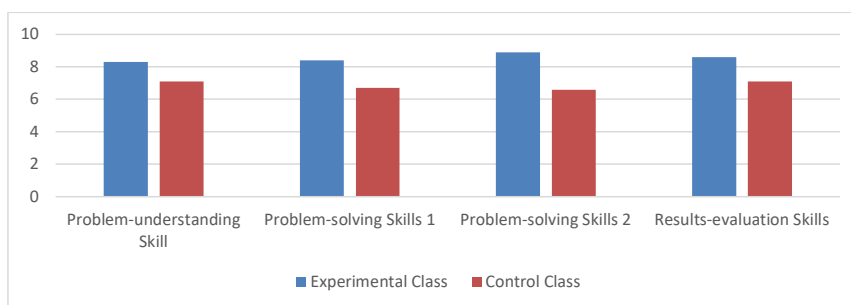


Figure 2. The Assessment of Scientific Literacy

The figure shows the average score of scientific literacy skills mastered by students. Problem-solving skills 2 obtained the highest average score of 8.9. Real Science Mask with QR Code integrated with several other digital application platforms can provide facilities for students to

carry out planning and real action to find a solution to solve the problems. The presentation of the image initially that does not have a written description makes students' curiosity stronger. Equipped with a QR Code, it will further increase students' desire to immediately find an answer to the image on the Real Science Mask.

Table 4. Independent t-test result

		Levene's Test for Equality of Variances		t-test for Equality of Means		95% Confidence Interval of the Difference				
		F	Sig.	t	df	Sig. (2-tailed)	(2-Mean Difference)	Std. Error Difference	Lower	Upper
nilai	Equal variances assumed	1.005	.331	8.951	16	.000	15.222	1.701	11.617	18.827
	Equal variances not assumed			8.951	14.913	.000	15.222	1.701	11.596	18.849

The posttest results obtained t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5% and $df = 16$ obtained 2,120. From these results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental class and the control class. The average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving the problem-solving skills and scientific literacy of students.

The unique phenomenon found during the implementation of this research is in problem solving skills, especially aspects of explaining scientific phenomena, because with the use of Real Science Mask media, students become highly curious after observing the images presented on the masks. Scientific evidence that has been obtained from various reliable sources is then interpreted and reduced by students who direct students to problem solutions (Asyhari, 2015). To find answers to problems and explain scientific phenomena well, students try to find scientific evidence to strengthen the opinions expressed.

CONCLUSION

Face-to-face learning activities during the COVID-19 pandemic are not allowed to avoid crowds of students in class. Learning activities are carried out online. Hence, simultaneous innovation is needed so that learning activities do not get boring and can achieve the learning goals. The Real Science Mask with QR Code is an innovation in learning media integrated with multiple digital platforms, such as YouTube, G-drive, and website. The results showed that the problem-solving skills in the skill to explain scientific phenomena had the highest score, and in scientific literacy, the problem-solving skills 2 also received the highest score. These two results indicate that Real Science Mask with QR Code can be an alternative media solution that can improve the problem-solving skills and scientific literacy of students.

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We are waiting for your response and congratulations once more.
Thank you for your cooperation.

All the best,

9. Diberikan LoA

Letter of Acceptance and Publication Receipt 📄

 **Jurnal Pendidikan IPA Indonesia** <jpii@mail.unnes.ac.id> to Erna Thu, Jun 3, 2021, 3:42 PM ☆

Dear Authors,

We are pleased to send the LoA and publication receipt of your manuscript.
It has been a pleasure to work with you.
Thank you very much.

Best regards,
JPPI Team

Jurnal Pendidikan IPA Indonesia

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LETTER OF ACCEPTANCE
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The officials of Jurnal Pendidikan IPA Indonesia (JPPI) (Nationally Accredited and Indexed by Scopus) give special thanks for submitting article for June 2021 Edition. Based on reviewers' decision, we as the officials stated that:

Article Title : **The Effectiveness of Real Science Mask with QR Code on Students' Problem-Solving Skills and Scientific Literacy**

Authors : **E. N Savitri, A. V Amalia, S. A. Prabowo, O. E Putri Rahmadani, A. Kholidah**



is **accepted** and is going to be published in JPPI June 2021 Edition.

The admission letter is made for appropriate use only. Thank you for the cooperation.

Semarang, 3rd June, 2021
Editor-in-Chief of JPPI,

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THE EFFECTIVENESS OF REAL SCIENCE MASK WITH QR CODE ON STUDENTS' PROBLEM-SOLVING SKILLS AND SCIENTIFIC LITERACY

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ABSTRACT

This study aims to determine the effectiveness of Real Science Mask with QR Code on students' problem-solving skills and scientific literacy. This research is a type of experimental research that uses the Pretest Posttest Control Group Design model. The subjects of this study were students in the Integrated Science Education study program for the academic year 2020/2021 of Universitas Negeri Semarang. The sample from the population was divided into experimental class and control class. The observation instrument used an observation sheet based on the assessment indicators of students' activities during learning. Data analysis in this study used quantitative descriptive analysis, where each average value is described in each aspect of the assessment based on indicators. The results showed that the experimental class that applied the Real Science Mask with QR Code had the highest average score of Problem-Solving skills in the assessment aspect of discussing the suitability of scientific phenomena with a score of 9.4 and scientific literacy on the aspect of student assessment in seeking scientific references with a score of 8.8. The posttest results obtained a t-count value of 8,951 with $df = 16$, consulted with the t-table value at a significance level of 5%, and $df = 16$ obtained 2,120. These results indicate that the value of t-count is greater than the t-table value ($8,951 > 2,120$) it means that there is a significant difference between the experimental and control classes. Furthermore, the average of these two aspects of the assessment is higher when compared to the control class. These results indicate that the Real Science Mask with QR Code is effective in improving students' problem-solving skills and scientific literacy.

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