

MONITORING BERICHT 2018/2019

DER STIFTUNG „HAUS DER KLEINEN FORSCHER“

GEFÖRDERT VOM



**Bundesministerium
für Bildung
und Forschung**

PARTNER:

Helmholtz-Gemeinschaft
Siemens Stiftung
Dietmar Hopp Stiftung
Deutsche Telekom Stiftung

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About the Foundation

The non-profit foundation Haus der kleinen Forscher (“House of Little Scientists”) is committed to high-quality early education in the fields of science, technology, engineering/computer science and mathematics (STEM) throughout Germany – with the aim equipping girls and boys effectively for the future and empowering them to take sustainable action. Together with its local network partners, the Foundation offers a professional development programme throughout Germany that provides ongoing support for early childhood educators, primary school teachers and leaders to support children of nursery and primary school age in exploration, inquiry and learning – and it has been doing so with great success since 2006. In this way, Haus der kleinen Forscher is dedicated to improving professional development opportunities, promoting interest in the STEM field and in sustainable development, and professionalising educational staff for this purpose.

The Foundation embraces STEM education with an awareness of responsibility for people and the planet. It bases its educational work on the global sustainability goals and seeks to contribute to sustainable development in the world at large.

The partners of Haus der kleinen Forscher are the Helmholtz Association, the Siemens Foundation, the Dietmar Hopp Foundation and the Deutsche Telekom Foundation. The initiative is funded by the Federal Ministry of Education and Research.

For further information, see haus-der-kleinen-forscher.de



Dear ,

As a foundation, we pursue a vision: we want to enable children at all childcare centres, after-school schools and primary schools throughout the country to engage with mathematics, computer science, natural sciences, technology and sustainability issues on a day-to-day basis. These institutions are to become “houses of little scientists”, where girls and boys are well equipped for the future by learning to think for themselves and act responsibly.

In our work, we continuously ask ourselves: are we on the right track with our professional development programme? What changes can we initiate through it? For this reason, the 2018/2019 Monitoring Report focuses on the impact of the initiative’s professional development programme, as was the case in the 2016/2017 issue. For the first time, we present data from various longitudinal studies conducted by the Foundation which enable us to gain a better grasp of the impact of our professional development programme.

I am very pleased with the results: the research findings presented here indicate that we have achieved success among the early childhood educators, primary school teachers and leaders who attend our professional development workshops. And participants are able to take away something of value with them for their day-to-day educational practice: our qualitative findings show examples of the opportunities and challenges that arise in the implementation of computer science education at childcare centres, after-school centres and primary schools.

For the first time, we also look at the impact of our professional development specifically on the directors of childcare centres. This is an exciting perspective that allows us to consider the institution as a whole and gain feedback from this for our projects that started in 2019 with a focus on organisational development at childcare centres.

All in all, the insights we have gathered will help us move forward and advance the work of the initiative – thereby getting closer to realising our vision.

Michael Fritz

Chair of the Haus der kleinen Forscher Foundation



Summary of the results

In the 2016/2017 Monitoring Report, the Foundation addressed the topic of the impact of early STEM education: based on a simplified chain of impact for the target group of educators, evidence was found that the programme offered by the educational initiative was indeed effective (cf. Stiftung Haus der kleinen Forscher, 2017a). This 2018/2019 Monitoring Report builds on this preliminary work carried out on the chain of impact, looking at how the professional development offered by the initiative contributes to improving early STEM education in Germany. Impact here is understood to mean changes achieved through participation in the professional development programme offered by Haus der kleinen Forscher; the focus is on the target group of early childhood educators, primary school teachers and, for the first time, on the target group of leaders, too. The cross-sectional impact analyses in the last publication are carried forward in this Monitoring Report. However, the impact assumptions are now presented in a more differentiated way based on a four-level model of professional development evaluation according to Kirkpatrick (cf. Kirkpatrick & Kayser Kirkpatrick, 2016). In addition, they are methodically supplemented by longitudinal study findings drawn from the Foundation's own monitoring and evaluation activities. This is the first time that the Monitoring Report has been able to show longitudinal correlations between attendance at Haus der kleinen Forscher professional development workshops and the skill development in educators.

Feedback from the professional development workshops shows that participants are highly satisfied with the programme. Furthermore, the results of the longitudinal study demonstrate educators' learning success in various skill areas as a result of pursuing professional development activities. An in-depth study identifies the impact of professional development in the area of early computer science education on the implementation of workshop content in educational practice. An evaluation of a professional development workshop on Education for Sustainable Development (ESD) provides evidence of the important role played by the childcare centre directors: the latter are especially responsible for relaying the content of professional development to the team as a whole, thereby contributing to educational concepts becoming established within the institution.

The results presented here follow on from the findings of the external accompanying research and bear out the impact of professional development in science on educators' skill development as demonstrated by these studies (cf. studies by EASI Science and EASI Science-L on the impact of science and language education in the context of professional development programmes for science: Pauen & Kästner, 2018; Rank, Wildemann, Hartinger & Tietze, 2018; Steffensky et al., 2018; Stiftung Haus der kleinen Forscher, 2018a).

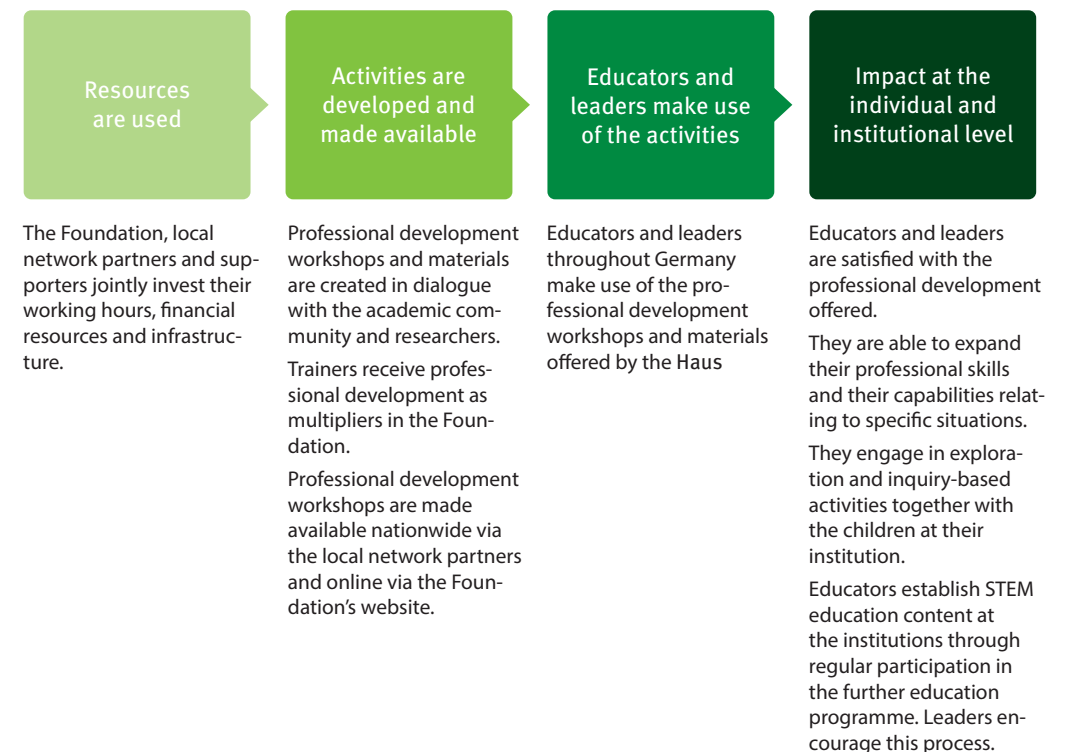
About the report

The impact logic of the Haus der kleinen Forscher educational initiative

The chain of impact explained in detail in the 2016/2017 Monitoring Report highlights the relationship between the planned impact and the resources required to achieve it. This shows how the Haus der kleinen Forscher educational initiative takes effect (see Figure 1). As an extension of the results presented in the last publication, the target group of early childhood educators, primary school teachers and leaders are presented here by way of examples, as are the institutions as a whole.

Figure 1

Simplified chain of impact of the Haus der kleinen Forscher initiative with regard to the target group of early childhood educators, primary school teachers, leaders and institutions



When an educator attends a Haus der kleinen Forscher professional development workshop for the first time, a process of individual development starts that progresses as their participation in the educational initiative continues, and this has an impact on that individual's educational work. An impact is taken to mean any change that can be achieved in the target groups through the work of the educational initiative.

Underlying questions and structure of the report

Based on the four building blocks of the simplified chain of impact (see page 7), the following questions are answered in the 2018/2019 Monitoring Report:

- What resources does the educational initiative use? (Building Block 1)
- How are activities developed and made available? (Building Block 2)
- How do early childhood educators, primary school teachers and leaders use the programme? (Building Block 3)
- What impact do the professional development activities have in terms of participants' satisfaction and learning success, transfer to educational practice and the institution as a whole? (Building Block 4)

In line with these four questions, the first results section sets out the human and financial resources used by the Haus der kleinen Forscher initiative to implement its work.

The second results section shows how the professional development programme is developed and made available by local network partners. In addition, this section includes a description of the scientific accompaniment and the Foundation's internal measures for monitoring and evaluation.

In the third results section, selected key figures are presented on the use of the professional development programme by early childhood educators, primary school teachers and leaders and information is provided on the educational institutions.

The fourth results section examines the impact of the professional development programme offered at individual and institutional level. In order to show the various ways in which the Haus der kleinen Forscher professional development programme has an impact, selected results are presented from four different studies drawn from the Foundation's own monitoring. In addition to participants' satisfaction with the professional development programme (feedback forms from the workshops), the other aspects examined are: learning success as a result of workshop attendance (longitudinal study), successful transfer to educational practice (based on the example of computer science education) and impact at the institutional level (based on the example of education for sustainable development).

Looking ahead to the future, the final section presents further projects and activities with which the initiative intends to expand its need and impact orientation.

Methodological notes

The Monitoring Report 2018/2019 presents selected results from different data sources of the Foundation's own quality monitoring. The data sources refer to different samples and vary in terms of methodology. Figure 2 shows an overview of the data sources on which the Monitoring Report is based. In addition, data from the Foundation's contact database is used to present key figures on such aspects as the number of active trainers and institution/educational institutions.

The period covered by this Monitoring Report is the year 2018 and the first half of 2019. Where key figures are presented for a period, these always refer to 2018. If the current status of a key figure is indicated, this is 30 June 2019. Whenever professional development workshops are mentioned in the following, they always refer to those offered by Haus der kleinen Forscher.

Differences between different measurement time points or compared groups are only reported if they are statistically significant. Significances shown refer to comparisons of averages using analysis of variance (ANOVA). The significance level is assumed to be $\alpha = 5$ per cent throughout.

In some of figures, the sum of the percentages does not add up to exactly 100 as a result of rounding up or down. The results presented here refer to the assumptions on which the chain of impact is based; data from the Foundation's own quality monitoring is evaluated for this purpose. The focus here is on the use of the professional development activities offered by the initiative and the impact achieved through participation in Haus der kleinen Forscher workshops. If you have any questions regarding the methodology used here, please contact the Foundation (see contact information on page 51).

Figure 2
Data sources of the 2018/2019 Monitoring Report

Source	Feedback from the professional development workshops (Database "Event planner")	Longitudinal survey	Evaluation of the professional development workshop Informatik	Evaluation of the professional development workshops on Education for
Sample	Training feedback from 934 professional development workshops provided by 8,580 educators who work at childcare centres, after-school centres and primary schools in 187 local networks	1,559 early childhood educators and primary school teachers who work at childcare centres, after-school care centres and primary schools in 17 local networks	Nine educators from seven childcare centres	458 educators from childcare centres, after-school centres and primary schools, and 176 childcare centre directors in 29 local networks
Description	The event planner is a digital platform used by network coordinators to organise the sign-up process for professional development workshops, for example, and issue attendance certificates. Feedback on professional development can also be submitted here.	Between September 2018 and February 2019, the first two data collection points of the longitudinal survey were carried out – before and immediately after workshop attendance. All topics addressed in the form of a face-to-face professional development workshop were examined. The Monitoring Report looks at the results regarding the learning success of all participants.	In April 2018, qualitative methods were used to examine the impact of professional development on learning success and transfer success. The Monitoring Report looks at the transfer success achieved by five early childhood educators.	Between May 2017 and April 2018, ESD evaluation data collection took place before attendance at an ESD professional development workshop and two to four months afterwards. The Monitoring Report looks at the results regarding the impact at institutional level for 156 early childhood educators and 81 childcare centre directors.

Use of resources



The resources of the Haus der kleinen Forscher educational initiative are the means used to be able to implement its work. Human resources include local network partners with their coordinators and trainers as well as Foundation staff. A Board of Trustees advises the Foundation on content-related and strategic issues, while the Scientific Advisory Board provides consultation on research issues and on the professional basis of the professional development offered.

The funds invested come from the Foundation, its network partners, donors and other supporters of the educational initiative. Most of the funding for the Haus der kleinen Forscher Foundation in 2018 was provided by the Helmholtz Association and the Federal Ministry of Education and Research (BMBF), partners such as the Siemens Foundation, the Deutsche Telekom Foundation and the Dietmar Hopp Foundation, as well as other donors such as aqtivator gGmbH (cf. Stiftung Haus der kleinen Forscher, 2019a).

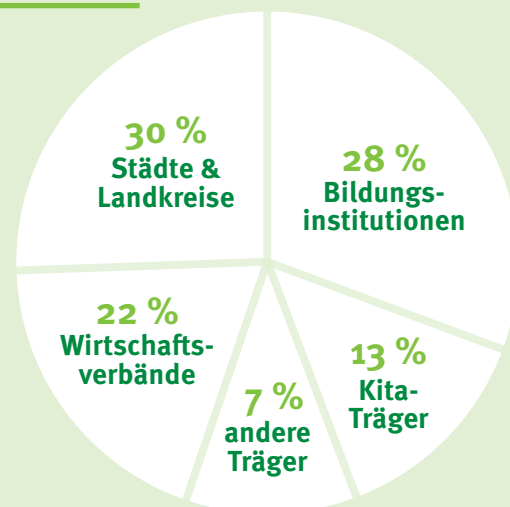
The educational initiative Haus der kleinen Forscher thrives nationwide on the financial and personal commitment of diverse network partner institutions – sponsors that form part of a decentralised multiplier model made up of local networks that act as partners and professional development providers in the regions. Their core tasks include encouraging early childhood educators, primary school teachers and leaders to participate in the professional development programme as well as the planning and implementation of the programme. Another important responsibility is ensuring their commitment is embedded in the local educational landscape. Activities here include public relations events such as symposiums, certification ceremonies and the annual "Little Scientists' Day". Currently (as of: 31 March 2019), there are 215 network partners throughout Germany. Firstly, they make personnel resources available in terms of both network coordinators and trainers. Secondly, they provide the necessary office infrastructure and material resources for the organisation and implementation of the professional development workshops, including information materials, training venues, travel expenses and catering as well as exploration and inquiry-based materials.

All these resources are necessary in order to develop, communicate and implement the professional development workshops.

Personelle und finanzielle Ressourcen der Bildungsinitiative

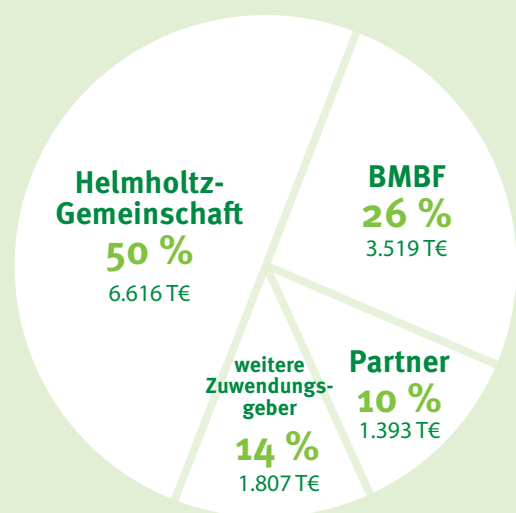
Stand: 31. März 2019

 **215 Netzwerkpartner**



 **315** Netzwerkkoordinator*innen
553 Trainer*innen

 **Stiftung**



Erträge aus Zuwendungen

 **197** Mitarbeiter*innen

Development and provision of the programme



Development of professional development workshops and materials

The educational approach of the Haus der kleinen Forscher Foundation is to view children as curious, active, competent and individual personalities. This image of the child, combined with the findings of research into learning and development, is what shapes the view of how children learn, how they explore the world and how educational action can be conceived on this basis. Educators can enable children to engage in experiences that help them expand their skills, find their own answers and gain a sense of self-efficacy (cf. Stiftung Haus der kleinen Forscher, 2019b). Introductory seminars present the educational concept of the Haus der kleinen Forscher Foundation to those interested.

With its diverse range of activities, the educational initiative seeks to support early childhood educators, primary school teachers and leaders in developing enthusiasm for exploration and inquiry-based learning among children, expand their educational support options, extend their understanding of subject-specific teaching methodology and practice, broaden their scientific mindset and approach, deepen their knowledge of STEM, consolidate their attitudes towards early STEM education, and encourage them to reflect on their professional role and self-image.

Two key processes for learning in the context of STEM education are exploration and inquiry. In day-to-day situations, children explore their surroundings: they show an interest, take time, observe and touch things, thereby actively engaging with their environment. Having gathered some basic experience relating to a topic, the focus shifts to a specific aspect based on an inquiry-based question or concrete idea. Inquiry involves phases that alternate between reflection and action. Exploration and inquiry-based learning founded on a scientifically based educational concept are components of all professional development programmes offered by the Haus der kleinen Forscher initiative.

All professional development topics are developed in accordance with the educational programmes and curricula of the federal states as well as in dialogue with educational experts and practical partners before being tested in an extensive pilot project in collaboration with a group of educators at childcare centres, after-school centres and primary schools. After the educators involved

have tested initial practical ideas for feasibility and given feedback on the Foundation's activities, the professional development concepts and materials are disseminated via the regional networks.

The Foundation provides materials free of charge at professional development workshops for the purpose of practical implementation at educational institutions: these include topic brochures, inquiry and exploration cards, teaching materials and examples on video (available at haus-der-kleinen-forscher.de).

Scientific accompaniment and quality monitoring

The quality monitoring implemented by the educational initiative Haus der kleinen Forscher applies internal evaluation measures and continuous monitoring to all activities and programmes. Cross-sectional and longitudinal data allow a view of both the current situation and the main changes over recent years. The longitudinal perspective has an increasingly important role to play as part of the Foundation's internal evaluation and monitoring measures in order to meet the demand for greater impact orientation.

For this reason, the feedback on professional development workshops that is regularly collected is supplemented with longitudinal elements wherever possible. When evaluating newly developed professional development workshops, the same individuals are repeatedly interviewed in time-limited surveys (see page 30). These in-depth analyses enable changes in skills through workshop attendance to be mapped so that the results can be fed into the development of new workshops. In addition, the Foundation has been conducting a long-term longitudinal survey since 2018 that looks at the professional development of educators across all training topics (see page 23). Here it is possible to examine the impact of the programme as a whole on educators' skills and attitudes well as on the implementation of workshop content in educational practice.

The educational initiative uses a theory-based evaluation approach in investigating its modes of impact. The focus is not so much on the relationships between cause and effect of its individual building blocks, but on a comprehensive model of assumptions about the intended (and unintended) impact of the initiative as a whole. The Foundation's own database systems are used to record information on professional development workshops and attendance. This data is used to map the progress of the programme and attendance patterns.

In addition to the above-mentioned internal evaluation measures and monitoring, the Foundation's work is also supported by external research conducted by renowned partners and analysed in the context of research projects. In this connection, the impact of science education programmes at the level of educational staff and children were examined by external research groups in two interdisciplinary studies (cf. Pauen & Kästner, 2018; Rank et al., 2018; Steffensky et al., 2018), while another study looked at the development of educators in STEM education (cf. Skorsetz, Röder, Schmidt & Kucharz, in preparation).

The Foundation makes all results of this scientific accompaniment and monitoring transparent. For example, publications such as the monitoring reports and the academic publication series containing all study reports are available on the website (haus-der-kleinen-forscher.de, see "Research and Monitoring").

Continuing education for trainers

A total of more than 550 trainers are involved in the nationwide Haus der kleinen Forscher professional development network (status: 31 March 2019). They lead the regional professional development workshops which educators attend. The trainers help participating educators to become familiar with the educational approach of the Haus der kleinen Forscher initiative, providing diverse practical suggestions to support exploration and inquiry-based learning and providing assistance in the application of these in their work with children.

For this task, network partners employ experienced staff who receive ongoing training from the Foundation. The trainers themselves either have an educational background or else they come from a profession related to science, technology, engineering/computer science and mathematics (STEM) or education for sustainable development (ESD).

A systematic application process ensures that prospective trainers are already able to draw on well-founded prior expertise for their work (cf. Stiftung Haus der kleinen Forscher, 2019c). Trainers who have been accredited by the Foundation use an extensive range of training measures offered by the Foundation for their work as training leaders, including professional development on the various STEM or ESD topics, special online learning activities, job shadowing and video coaching. In 2018, the Foundation conducted 63 advanced workshops for trainers. It also developed nine different profile workshops with the aim of strengthening trainers' adult education skills. This also includes a two-day and a three-day profile workshop in which trainers engage in exploration and inquiry-based activities together with children at an educational institution and are accompanied by experts from the Foundation. The profile workshops are provided on request by network partners within the networks as well as being offered by the Foundation at annual summer or winter campus. The Foundation's ongoing individual development support helps trainers in their professional development practice. Regular reaccreditation also ensures continuous contact between trainers, the respective network partner and the Foundation.

The initiative's professional development programme

In terms of content, the programme includes the educational areas of science, technology, engineering, and mathematics (STEM) as well as education for sustainable development (ESD). The professional development workshops are designed for educators at childcare centres, after-school centres and primary schools, as well as childcare centre directors (in the area of ESD). The theme-based professional development workshops are offered on-site, while the general educational fundamentals of the Haus der kleinen Forscher Foundation are offered in the form of on-site professional development workshops, (online) self-education activities or as professional development events (see page 17).

The Foundation provides a constantly growing range of online activities for early childhood educators, primary school teachers and leaders that allow flexible, individual professional development free of charge. Educators work can use open-access online courses to work independently on the material at their own pace. Facilitated online courses take place over a set period of time. Here, the content is developed in collaboration with other participants with the support of a facilitator. Web-based seminars ('webinars' for short) take place on a specific date and include an interactive online talk. These are self-contained professional development workshops: this is why these three types of online activity are grouped together as online professional development workshops in the figure shown here. In addition, there are other online activities such as podcasts, videos and games for children that can be used at any time.

In terms of content, the range of face-to-face professional development workshops has been expanded since autumn 2018 to include the workshop Technik – von hier nach da ("Technology – from A to B") in the area of technical education, while the interdisciplinary topic MINT ist überall ("STEM is everywhere") has been offered (see page 46) since autumn 2019. In addition to a total of 16 face-to-face professional development workshops on STEM topics, the Foundation's programme has been expanded to include the new workshop Tür auf! Mein Einstieg in Bildung für nachhaltige Entwicklung ("Open the door! My introduction to education for sustainable development") and Macht mit! Bildung für nachhaltige Entwicklung in der Praxis ("Join in! Education for sustainable development in practice"), which are designed for educators and specifically for childcare centre directors (see page 36).

Fortbildungsangebot der Initiative

Stand: 31. März 2019



bundesweite Fortbildungen vor Ort



47 Online-Fortbildungen



24 weitere Online-Angebote

Use of the programme by early childhood educators, primary school teachers and



leaders

Educators opt to attend a Haus der kleinen Forscher workshop and make use of the professional development programme. This programme is continuously expanded and extended so as to enable early childhood educators, primary school teachers and leaders to develop their skills on an ongoing, sustainable basis. By mid-2019, around 78,000 educators at around 31,700 childcare centres, after-school centres and primary schools had taken part in the professional development programme¹. The participating institutions are attended by approximately 2.6 million children.

The initiative also offers educational institutions the opportunity to obtain certification for their quality assurance and development, enabling them to obtain the title Haus der kleinen Forscher ("House of Little Scientists"). This certification is free of charge to institutions and based on a scientifically robust process (cf. Stiftung Haus der kleinen Forscher, 2017b). When participating in the certification procedure, educational quality is evaluated with regard to the implementation of STEM education, ESD, and exploration and inquiry-based learning with children. Participating childcare centres, after-school centres and primary schools are also supported in their quality development by practical suggestions and tips provided by the Foundation. Follow-up certification every two years enables the long-term establishment and further development of educational quality. By mid-2019, some 5,200 childcare centres, after-school centres and primary schools will have received the Haus der kleinen Forscher certificate.

¹ The Haus der kleinen Forscher programme applies to institutions covered by the German term Kita: this includes kindergartens, childcare centres, alternative childcare facilities and pre-school institutions attended by children aged between 3 and 6.

Nutzung des Fortbildungsangebots

Stand: 31. März 2019



Teilnahme am

FORTBILDUNGSPROGRAMM

rd. **25.600**
Kitas

rd. **1.500**
Horte

rd. **4.600**
Grundschulen



als „Haus der
kleinen Forscher“

ZERTIFIZIERT

rd. **4.800**
Kitas

rd. **170**
Horte

rd. **250**
Grundschulen



fortgebildete

PÄDAGOG*INNEN

rd. **66.000**
in Kitas

rd. **3.000**
in Horten

rd. **9.000**
in Grundschulen



KINDER

in den teilnehmenden Einrichtungen

ca. **1.640.000**
in Kitas

ca. **125.000**
in Horten

ca. **834.000**
in Grundschulen

Nutzung des Bildungsangebots

im Jahr 2018

rd. **2.200**

Präsenzfortbildungen für pädagogische Fach- und Lehrkräfte



11 Teilnehmende im Durchschnitt



rd. **40**

Präsenzfortbildungen für Leitungskräfte



8 Teilnehmende im Durchschnitt

am häufigsten besuchte
Präsenzfortbildungen



13 %
Forschen mit Wasser



13 %
Informatik entdecken – mit und ohne Computer



11 %
Forschen rund um den Körper



von allen am häufigsten genutzte

Online-Angebote

1

Grundlagenseminar – Der pädagogische Ansatz der Stiftung „Haus der kleinen Forscher“

2

Fragen, die das Forschen unterstützen

3

Typisch Technik – welcher Techniktyp sind Sie?

impact at the individual and institutional level



The impact of the Haus der kleinen Forscher professional development programme can be observed at different levels and is taken to mean any changes that can be triggered through the implementation of professional development content. To illustrate the range of changes, the following presentation of selected results from the Foundation's own quality monitoring is based on Kirkpatrick's four-level model (cf. Kirkpatrick & Kayser Kirkpatrick, 2016). Using this well-known model to evaluate professional development and further education, it is possible to provide a differentiated impression of how the Haus der kleinen Forscher educational programme takes effect at various levels (see Figure 3).

Figure 3
Four-level model of professional development evaluation according to Kirkpatrick

Level	Focus area	Guiding questions
1st level	Participants' response	How satisfied were participants with the professional development workshop?
2nd level	Participants' learning success	What did participants learn?
3rd level	Participants' transfer success	How did participants implement the content of the professional development workshop?
4th level	Impact at the institutional level	What impact is evident at the institution as a whole

The first two levels take a closer look at the educators themselves, asking about their satisfaction with the workshop attendance and examining the extent to which they were able to achieve learning success as a result of receiving Haus der kleinen Forscher professional development. The third level focuses on the transfer of what has been learned to educational practice. In addition to participants' learning success, the framework conditions at the educational institutions also have a role to play here: these can have a beneficial or detrimental effect on the implementation of professional development content. At the fourth level, the perspective is broadened further, focusing on the institution as a whole. Here, the aim is to explore any indications of the impact of the professional development programme on the educational work being done at the institution as a whole.

Participants' response: satisfaction with the professional development programme

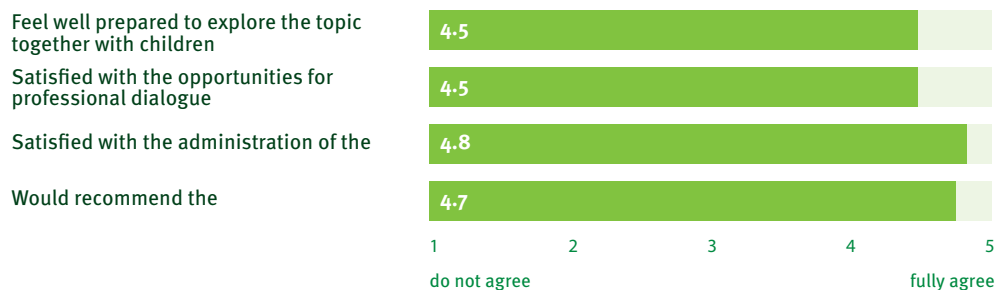
The first level of the four-level model according to Kirkpatrick looks at the level of satisfaction among educators in terms of the Haus der kleinen Forscher professional development programme. If participants are satisfied, an important foundation stone will have been laid for the ongoing progression of the chain of impact.

After each professional development workshop, educators are given the opportunity to submit an anonymous evaluation. For 2018, feedback is available from 934 professional development workshops with a total of 8,580 participants. The feedback relates to all professional development topics from the face-to-face workshops offered by the initiative.

This feedback for 2018 shows that educators are very satisfied with the professional development provided by the Haus der kleinen Forscher initiative. They feel well prepared for the implementation of the topic dealt with and are very satisfied with the opportunities for professional dialogue as well as with the administration of the professional development. Most of the educators would recommend the workshops to their colleagues (see Figure 4).

Figure 4
Educators' evaluation of all professional development workshops attended

Data from 934 professional development workshops



The level of educator satisfaction with Haus der kleinen Forscher professional development workshops has been very stable for many years. The positive evaluations submitted by professional development participants have already been included in the monitoring reports for previous years (cf. for example Stiftung Haus der kleinen Forscher, 2017a). Differentiated comparisons between the various face-to-face professional development workshops also indicate that the level of participant evaluation is always relatively high, regardless of the professional development topic.

Participants' learning: impact of the Haus der kleinen Forscher professional development workshops on educators' skills

The second level of Kirkpatrick's four-level model focuses on participants' learning success as a direct result of attending a professional development workshop. Learning success is favoured by satisfaction with the workshop (see page 22) and is also a prerequisite for transferring what has been learned to educational practice (see page 30).

Early childhood educators and primary school teachers accompany and support children in a constantly changing world. The Haus der kleinen Forscher initiative pursues the goal of strengthening educators in their role as STEM learning facilitators, giving them the opportunity to expand and deepen their STEM expertise and the educational strategies this involves. The efforts of the Haus der kleinen Forscher Foundation at the level of the early childhood educators and primary school teachers themselves are fundamental to the effectiveness of the professional development programme. The aim is to arouse enthusiasm for exploration and inquiry-based learning among children, expand educational support options, extend understanding of subject-specific teaching methodology and practice, broaden the individual's scientific mindset and approach, and consolidate expertise and attitudes regarding early STEM education as well as the educators' professional role and self-image. (cf. Stiftung Haus der kleinen Forscher, 2019b).

The 2016/2017 Monitoring Report presented initial analyses of the educational initiative's impact correlations. Group comparisons provided indications that the more educators participate in the Haus der kleinen Forscher professional development workshops on a continuous basis, the more they benefit. It was possible to show that the number of professional development workshops attended correlates with an increase in expertise and changes in self-efficacy expectations, as well as increased frequency and improved quality in terms of the inquiry-based activities pursued with children (cf. Stiftung Haus der kleinen Forscher, 2017a).

These results are in line with the findings of the external research projects EASI Science and EASI Science-L: educators who have undergone professional development in the natural sciences have a higher level of subject expertise and a more advanced grasp of subject-specific teaching methodology than a comparable group who lack this professional development background. They are also more motivated and take a greater interest in science education (cf. Steffensky et al., 2018).

Since autumn 2018, the Foundation has been conducting a long-term longitudinal survey in order to ascertain the impact of the professional development programme as a whole on educators' skills and attitudes with regard to early STEM education and the implementation of workshop content in educational practice. This longitudinal survey now enables educators' professional development to be traced across all topics.

Sample and procedure adopted for the longitudinal survey

From September 2018 to February 2019, 1,559 educators from all over Germany were involved in the first two parts of the longitudinal survey. They were interviewed at one of 167 professional develop-

ment workshops on all topics offered in 17 networks throughout Germany. The topics covered the entire spectrum of the educational initiative's extensive range of face-to-face professional development workshops on STEM education and ESD.

For the first part of the longitudinal survey, participating educators were questioned before attending a Haus der kleinen Forscher professional development workshop. The second questionnaire was completed immediately after attendance at this workshop. Based on a before-and-after comparison, the direct impact of a Haus der kleinen Forscher professional development workshop on educators' skills are presented below.

The majority of participants (around 60 per cent) had already attended several of the initiative's professional development workshops before the first part of the survey was conducted. Nevertheless, the share of educators who had not previously participated in a Haus der kleinen Forscher professional development workshop is comparatively high in the present sample, at just under 40 per cent. This is due to the design of the longitudinal survey, which aims to question the same educators at regular intervals over a period of several years about the long-term impact of the professional development programme. Since large numbers of educators attend professional development workshops over the years, the share of newcomers to the professional development programme gradually gets smaller; this means that in the first two parts of the survey in particular, there is a higher percentage of newcomers to the programme.

In the following, the learning success of all participants is first analysed by comparing different target areas before and after attending the professional development workshop. All the survey instruments presented here were developed by the Haus der kleinen Forscher Foundation. In order to get closer to establishing which groups of people benefit from a professional development workshop and how, the next step is to look at how the differing ways in which participants experienced the workshops impact on learning success.

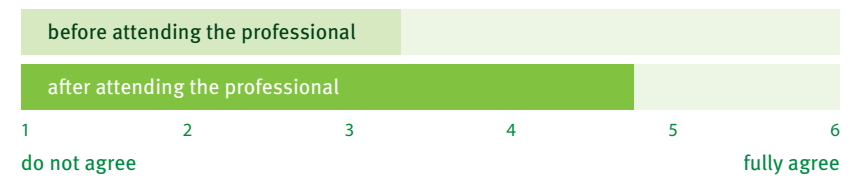
Impact on self-confidence in putting the professional development topic into practice

Both before and after attending a professional development workshop, the educators assessed how confident they felt about the idea of implementing the workshop topic with children. What is meant here is a specific self-confidence relating to the content of the professional development workshop attended by the educators between part one and two of the survey.

Immediately before the workshop, the tendency is for educators to feel somewhat insecure. After attending the workshop they feel much more secure – on average, educators feel confident enough to implement the topic with children at this point (see Figure 5).

Figure 5
Development of self-confidence in putting the professional development topic into practice

Data from 1,429 educators

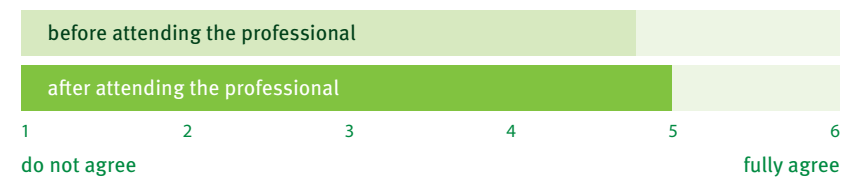


Impact on self-efficacy expectations in relation to exploration and inquiry-based activities with children

Self-efficacy expectations means expectations of oneself to be able to perform a certain action successfully based on one's own abilities. In the longitudinal survey, educators were asked in general about their level of confidence, firstly in engaging in spontaneous exploration and inquiry-based activities with children on a day-to-day basis and secondly in planning and carrying out inquiry-based projects. The results show an increase in the self-efficacy expectations of all educators as a result of attending the professional development workshop (see Figure 6).

Figure 6
Development of self-efficacy expectations in relation to exploration and inquiry-based activities with children

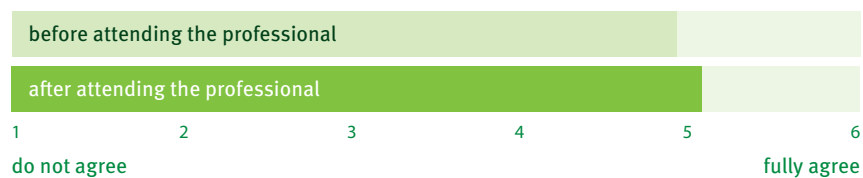
Data from 1,374 educators



Impact on motivation in relation to exploration and inquiry-based activities with children

In order to assess educators' motivation, they were asked about their level of enjoyment, firstly in engaging in spontaneous exploration and inquiry-based activities with children on a day-to-day basis, and secondly in planning and carrying out inquiry-based projects. Educators' level of motivation was already high before attending the professional development workshop, but it reached an even higher level afterwards (see Figure 7).

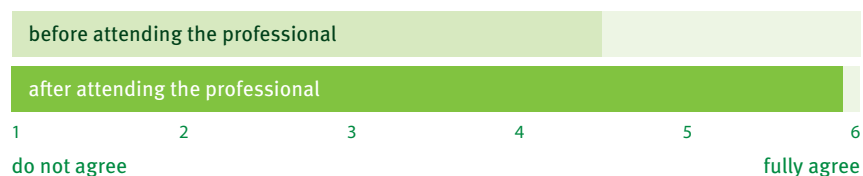
Figure 7
Development of motivation in relation to exploration and inquiry-based activities with children
Data from 1,390 educators



Impact on expertise relating to exploration and inquiry-based activities with children

Educators' expertise was assessed based on a self-assessment of their own level of expertise, firstly concerning spontaneous exploration and inquiry-based activities with children on a day-to-day basis and secondly concerning the planning and implementation of inquiry-based projects. The results show that the educators rate their expertise as being higher after attending the professional development workshop than before (see Figure 8).

Figure 8
Development of expertise in relation to exploration and inquiry-based activities with children
Data from 1,376 educators



Impact of the professional development experience on learning success

Since it was shown in the present longitudinal survey that essentially all participants benefit from attending a Haus der kleinen Forscher professional development workshop, the question arises as to whether and to what extent there are deviations in the impact of a professional development workshop within a group of individuals with different backgrounds.

The fundamental assumption is that educators' experience increases successively as they attend more Haus der kleinen Forscher professional development workshops, as reflected in the areas of motivational aspects, professional skills and educational practice. The studies presented in the 2016/2017 Monitoring Report (cf. Stiftung Haus der kleinen Forscher, 2017a) underscore these assumptions, as do the findings of the external research projects EASI Science and EASI Science-L (cf. Pauen & Kästner, 2018; Rank et al., 2018; Steffensky et al., 2018).

The Haus der kleinen Forscher professional development workshops are open to all educators and do not have to be attended in a prescribed order. As a result, participants taking any given workshop may differ significantly in terms of their previous professional development experience. For this reason, it is interesting to find out how workshop attendance impacts on the skills of groups of individuals with varying experience of professional development: for example, does an educator attending their very first Haus der kleinen Forscher professional development workshop benefit to the same extent as an educator who has been attending such workshops for many years?

For this purpose, respondents were divided into groups according to the number of Haus der kleinen Forscher professional development workshops they had previously attended – in the same way as for the 2016/2017 Monitoring Report: three groups consisting of educators who had previously attended one to two ($n = 349$), three to five ($n = 282$) or six or more workshops ($n = 267$). In addition to these participants with professional development experience (around 60 per cent of those surveyed), a group of educators were surveyed who were attending a Haus der kleinen Forscher workshop for the first time ($n = 649$, i.e. approximately 40 per cent of those surveyed). In the following, a group comparison is carried out between participants with different levels of experience (no experience – limited experience – a lot of experience) of the Haus der kleinen Forscher initiative; by way of an example, this is applied to the area of expertise in relation to exploration and inquiry-based activities with children. Similar results are also shown for motivation and self-efficacy expectations in relation to exploration and inquiry-based activities with children.

All in all, an increase in learning can be observed in all subgroups as a result of attending the professional development workshops (see Figure 9).

Figure 9
Development of expertise in relation to exploration and inquiry-based activities with children according to the number of professional development workshops attended

Data from 1,364 educators



Firstly, group differences in the longitudinal section can be seen in the different groups by looking at learning progress, i.e. the increase in level after attending the professional development workshop: the increase in self-assessed expertise in relation to exploration and inquiry-based activities with children is greatest in the group of the newcomers to professional development. So if one considers a single Haus der kleinen Forscher professional development workshop, the reported learning success is greatest among educators participating for the first time. Learning progress derived from a single professional development workshop is not as high in the groups with more professional development experience as it is in the groups of educators without professional development experience, though even the more experienced participants achieve some progress.

Secondly, differences in the groups can also be seen based on a cross-sectional view: if one compares the outcomes of the different groups for self-assessed expertise in relation to exploration and inquiry-based activities with children for the individual parts of the survey, it becomes apparent that the group that previously attended six or more professional development workshops have the highest levels in each case. The more professional development workshops the educators have attended previously, the higher they rate their expertise – both immediately after taking the workshop (level after workshop attendance) and on a long-term basis (level prior to workshop attendance).

As reported, the same tendencies are also evident for the target areas of motivation and self-efficacy. Only in the area of self-confidence in relation to the implementation of the professional development topic is it not possible to identify any group differences in learning success based on the number of professional development workshops attended. However, this question relates to the specific topic of the professional development workshop that the educators are attending at the time of the survey, so they are very unlikely to be familiar with this topic beforehand. As is to be expected,

educator self-assessment in this regard is barely influenced by previous attendance at professional development workshops on other topics. In the areas of motivation and self-efficacy, on the other hand, as with expertise, there seems to be a long-term, cumulative increase over numerous professional development workshops.

Summary: Impact at the level of learning success

A longitudinal survey showed the impact on self-reported learning success in various target areas and across all face-to-face professional development workshops for over 1,500 educators. Educators rate themselves significantly more highly after attending the professional development workshop than before, especially with regard to their self-confidence in implementing the professional development topic and their expertise in engaging in exploration and inquiry-based activities with children. Motivation and self-efficacy expectations with regard to exploration and inquiry-based activities with children are already highly rated prior to workshop attendance and continued to rise.

Group comparisons provide indications of how Haus der kleinen Forscher professional development workshops have an impact on learning success: educators who have not previously attended any professional development workshops show most growth in the target areas examined. As such, they benefit more in the short term – from a single professional development workshop – than the comparison groups who have more experience of professional development. At the same time, the more Haus der kleinen Forscher workshops an educator with a lot of experience of professional development has attended beforehand, the higher they rate their motivation, their self-efficacy expectations and their expertise. This suggests that the Haus der kleinen Forscher professional development programme has a lasting impact on the learning success of educators.

More on the longitudinal survey in Volume 13 of the academic publication series (cf. Stiftung Haus der kleinen Forscher, in preparation)

Participants' transfer success: impact of professional development in the area of computer science education on educational practice

The third level of Kirkpatrick's four-level model is concerned with the transfer of professional development content to educational practice. If learning has been successful – i.e. if the professional development workshop has had a positive impact on participants' attitudes, expertise and skills (see page 23) – this can lead to a change in practical behaviour. This section takes the example of the professional development workshop *Informatik entdecken – mit und ohne Computer* ("Discovering computer science – with and without computers" (cf. Stiftung Haus der kleinen Forscher, 2017c) to look at what other conditions are necessary for educators to implement the content of a professional development workshop in practice with children.

In autumn 2017, the Haus der kleinen Forscher Foundation started offering computer science professional development workshops for educators at childcare centres, after-school centres and primary schools for the first time. This programme gives educators a variety of suggestions and practical examples as well as support in putting computer science education into practice together with children. The target dimensions of the professional development workshop relate to motivation, interest, self-efficacy expectations, attitudes, orientations and role understanding with regard to implementation of the topic with children, as well as computer science expertise, grasp of computer science teaching methodology and key skills in handling digital media (cf. Bergner et al., 2018). In addition to face-to-face professional development workshops, educators receive further suggestions through an additional online programme about how they can engage in exploration and inquiry-based activities relating to computer science topics with children.

In order to learn more about the impact of this professional development programme at the transfer level, a mainly qualitative investigation was carried out to find out how participants perceive changes as a result of workshop attendance, how they implement professional development content, and what difficulties and success factors they come across.

Sample and procedure adopted for the evaluation of professional development

These results are drawn from the evaluation of a professional development workshop on the topic *Informatik entdecken – mit und ohne Computer* ("Discovering computer science – with and without computers") in April 2018, which was attended by a group of educational professionals from seven childcare centres run by the same provider. Similar to what was described for the longitudinal survey (see page 23), the evaluation involved a written survey carried out among educators to assess learning success both before and immediately after the professional development workshop.

Transfer success was also considered here, i.e. implementation of the professional development content in educational practice: for this purpose, a qualitative survey using guideline-based interviews was conducted with five of the educational professionals approximately three months after

they had attended the professional development workshop. Here, the educators reflected on the changes that had occurred in their attitudes towards computer science education and computer science as well as their grasp of subject-specific teaching methodology and their subject expertise. The evaluation combines quantitative and qualitative methods of data collection and analysis.

It shows how the educators perceive the changes that occurred in their educational practice three months after attending the workshop, how they implement computer science education as inspired by the workshop and which factors proved to be problematic or beneficial.

Subjectively perceived impact of workshop attendance

After attending the professional development workshop *Informatik entdecken – mit und ohne Computer* ("Discovering computer science – with and without computers"), clear learning success can be observed as compared to before the workshop. Educators certainly tended to have a generally positive attitude towards computer science education before attending the workshop. They were interested in the content of computer science education and were also motivated to put this content into practice; what is more, they had the confidence to do so even before attending the workshop. Nonetheless, most of them regarded themselves as lacking the relevant subject expertise and grasp of subject-specific teaching methodology. Attendance at the professional development workshop had the effect of boosting this positive attitude. In the area of expertise, the increase was even more significant as compared to the level prior to workshop attendance. The results regarding changes in the areas of motivation, self-efficacy expectations and expertise correspond to those from the longitudinal survey (see page 23).

Learning success

The impact on learning success of the workshop *Informatik entdecken – mit und ohne Computer* ("Discovering computer science – with and without computers") was also studied longitudinally in 2017 as part of the piloting of this new professional development topic with around 50 educators. The design and measurement instruments were largely the same as those described here for the evaluation. The results in terms of the impact on attitudes and expertise point in the same direction as those shown here (cf. Brünger, Franke-Wiekhorst, Griffiths, Günther & Radtke, 2019).

Three months after attending the workshop, educators reported "greater confidence in their own abilities" and an increased curiosity to "get a taste" of the unknown with regard to their attitudes to computer science education and computer science itself. They said that since attending the workshop, computer science had become much more "self-evident", while at the same time the motivation to continue working on the topic had increased:

"I now want to

"A new area of interest"

one educational expert said with regard to her subject expertise and her grasp of subject-specific teaching methodology that she had been able to achieve a greater sense of familiarity with computer

science and felt she was able to make links to computer science more readily in the course of her day-to-day teaching based on a more sound understanding.

Regarding changes in expertise, respondents stated that important gaps had been filled and that they were now more aware of previously existing knowledge:

“The whole thing is now being given a name”

in addition to the now familiar “basic technical terms”, educators benefited from the fact that they were able to implement computer science education in a much more targeted way with children in their day-to-day work after attending the workshop. They said that even though they were not able to precisely reproduce the definitions of the technical terms covered, the build-up of expertise enabled them to respond to children’s questions more competently. One important aspect of this was also communication with parents, they said: one educator noted her increased expertise had helped her allay parents’ fears and reservations regarding the use of digital devices at the childcare centre.

Educators’ reflection on their learning success shows that both the increase in expertise and motivation measured immediately after the workshop and the changes in attitude towards computer science and computer science education three months after the workshop are perceived as “lasting changes” by educators in their day-to-day work. For these educators, the professional development on the subject of computer science has an impact for at least three months, and this helps them implement computer science education with children.

Implementing early computer science education – practical examples

In the first three months after attending the professional development workshop, the content of the workshop was implemented by educators to very varying degrees. Some of the educators implemented or developed two practical ideas from the exploration cards or examples that they found out about at the workshop, others did so with as many as six (cf. Stiftung Haus der kleinen Forscher, 2017c).

At one institution, pictograms were placed in various rooms such as the bathroom and utility room depicting rule-governed processes action.

“It’s a good way of understanding

In the future, this method is also be used at the childcare centre in question to plan more complex play sequences together with the children.

One teacher picked up on the idea of the “grid” from the professional development workshop to give children their first experience of the alphabet and to work together to explore the phenomenon of pixels. The children placed small tiles on grids consisting of five or ten squares to create different letters. They discovered that a minimum number of tiles was necessary to ensure legibility when reproducing the letters, and that the distance from the letter was very important. Another teacher

allowed the children to encode images themselves. To do this, the children broke down images into numbered pixels and then reassembled them. One of the educators surveyed introduced the children to the topic of algorithms using Lego building instructions.

Three months after attending the professional development workshop, the educators still had ideas about how to integrate computer science education in the day-to-day routine of the childcare centre – for example by developing their own Lego instructions which the children were to design so as to be able to plan and implement action sequences when building Lego models.

In addition to activities initiated and planned by the educators, links to computer science also emerged in dialogue with the children:

“Lots of what children talk about is relevant to computer science. Especially when it comes to their parents’ jobs or their elder siblings’ computer games.”

the educators reported that the professional development workshop made it easier for them to identify links in discussions, thereby enabling them to spontaneously incorporate computer science education in their day-to-day work at the childcare centre during their interactions with the children.

Success factors and difficulties in implementing computer science education

The practical examples presented show that the educators surveyed were able to implement computer science education without computers in their day-to-day work with children. Difficulties in using computer science arose for respondents partly due to the lack of digital equipment at the institution.

“The only tablet at the childcare centre is my own. The centre itself is very poorly equipped.”

In the educators’ private lives – and frequently in the lives of the children, too – digital devices such as smartphones, tablets or laptops have long been indispensable, whereas they are hardly relevant in day-to-day educational routine at the childcare centre.

This finding is in line with the results of a representative telephone survey of educators and leaders conducted by the Foundation in 2017. At the time of the survey, about 42 per cent of respondents were dissatisfied or somewhat dissatisfied with the technical equipment available at their childcare centre. Nearly a third of childcare centres in Germany do not provide children with digital devices for shared use with educators. Only 19 per cent of childcare centres have binding regulations – a so-called media concept – for the use of digital devices at the institution (cf. Stiftung Haus der kleinen Forscher, 2017d).



The educators surveyed said they would like to see a guideline or other binding agreement that enables and regulates the use of digital devices at childcare centres. The reason for this is that some educators and especially parents are concerned about the use of digital devices by children. Accord-

ing to educators, it is important to allay parents' fears when it comes to their children using tablets or smartphones.

Other difficulties mentioned by the respondents that influence the implementation of computer science education in day-to-day educational life relate to the overall conditions at the institution. From the point of view of most of the educators surveyed, an acute lack of resources in terms of time and personnel has a negative impact on the quality of education on a day-to-day basis. They say that this is why computer science education is integrated in educational work with children mainly on a spontaneous basis and is not planned in advance:

“It’s difficult for me to take time to specifically do the card activities with children myself. Instead I

one of the educators surveyed described the problem by saying that her own skills were not yet sufficient to allow spontaneous implementation of computer science education after attending only one professional development workshop. According to this educator, more preparation time had to be planned for the implementation of computer science education. The increased effort this involved was why the implementation of computer science education at the institution was hesitant. She said it seemed that some educators lacked the time to integrate computer science education into day-to-day routine in a way that was explicitly planned and in the context of prepared learning situations. According to some educators, experience and professional skills were lacking for the spontaneous implementation of computer science education in a way that was oriented towards the children and their interests. For this reason, several educators said they would like more professional development on computer science education so as to be able to build on the skills they had acquired.

In addition, some respondents said they wanted to see more concrete examples of the implementation of computer science education in more difficult educational situations, such as with larger groups of children. This would give them an introduction to good examples of how to implement computer science education at the childcare centre even with large numbers of children, despite the lack of staff.

In one of the guideline-based interviews, an educator mentioned that she found the additional online course on computer science education offered by the Haus der kleinen Forscher Foundation to be very worthwhile. Where there was some uncertainty, she said she felt

“the online activities are a great help. I like to use the HdKF website as a way of refreshing my knowledge, too.”

When asked about aspects that positively influence the implementation of computer science education at a childcare centre, educators said that the support of the childcare centre leadership and a good team structure were important success factors. In the opinion of educators, the childcare centre management should be sensitised to the importance of computer science educational content and contribute to structurally establishing the implementation of this material by means of internal com-

munication measures. This in turn would influence the entire childcare team so that the necessary time, personnel and financial resources could be made available to successfully implement computer science education at the childcare centre.

These points requested by educators fit in with the results of the evaluation of the ESD professional development workshops described below, which highlight the particular role of childcare centre leadership in establishing professional development content and methods at the institution (see pages 36-40).

Summary: Impact at the level of learning success

Three months after attending a professional development workshop on the topic Informatik entdecken – mit und ohne Computer (“Discovering computer science – with and without computers”), a small group of educators took part in a qualitative survey in which they describe continuous changes: after attending the Haus der kleinen Forscher professional development workshop, they say they are now able to implement computer science education more naturally in their day-to-day practice and feel more confident about addressing the topic, both with children and parents. The educators describe numerous different examples of how they implement planned computer science activities with children and also tell of spontaneous situations in which they find links to computer science on a day-to-day basis. Most of them say that difficulties arise from the lack of digital equipment at the childcare centre; implementation of computer science education is also hindered because of parents' reservations and colleagues' insecurity surrounding the subject. The lack of time and personnel resources at the institution is another fundamental obstacle to the planning and implementation of educational activities with the children. One of the factors conducive to implementation is the structures of the institution: these include communication within the team and the establishment of computer science education as part of the institution's underlying concept.

More on the evaluation of Informatik entdecken – mit und ohne Computer (“Discovering computer science – with and without computers”) in Brünger et al, 2019

Impact at the institutional level: Impact of the professional development workshops on education for sustainable development



The fourth level of Kirkpatrick's four-level model looks at the educational institution as a whole and examines what indications there are of the impact of professional development attendance (cf. also earlier results on institution certification in the Monitoring Report 2015: Stiftung Haus der kleinen Forscher, 2015).

The Haus der kleinen Forscher Foundation has offered its professional development workshops and materials on education for sustainable development (ESD) to childcare centres, after-school centres and primary schools since 2018. ESD is a modern educational concept that encourages children to explore, understand and actively engage in shaping the world in a spirit of sustainable development, despite its complexity and limited resources. In addition to two consecutive professional development workshops for educators, the initiative also tailored these two ESD professional development workshops for the first time specifically to childcare centre directors, thereby supporting the institution as a whole in sustainably establishing ESD in day-to-day educational practice (cf. Stiftung Haus der kleinen Forscher, 2018b, 2018c).

The aim of the first ESD professional development workshop (Tür auf! Mein Einstieg in Bildung für nachhaltige Entwicklung – "Open the door! My introduction to education for sustainable development") is to arouse interest in this area of education and increase motivation to address the topic, as well as developing background knowledge and initial ideas for implementation at the institution. Participants are to be encouraged to embark on establishing ESD at their institution. At management level, childcare centre directors are to be able to lay sound foundations for the institution as a whole to develop sustainably based on the knowledge they have gained and their changed attitude towards sustainability. The second professional development workshop (Macht mit! Bildung für nachhaltige Entwicklung in der Praxis – "Join in! Education for sustainable development in practice") involves in-depth reflection on the initial experience gained. The evaluation reported here focuses on the impact of the introductory workshop.

Procedure and sample adopted for the evaluation of the professional development programme

The ESD professional development programme was extensively evaluated in 28 model networks (cf. Stiftung Haus der kleinen Forscher, 2019d). Part of this evaluation consisted of a longitudinal survey in which early childhood educators, primary school teachers and childcare centre directors were questioned between May 2017 and April 2018 – before the start of the first ESD professional development workshop and two to four months afterwards. The results presented here are based on data from 156 educators and 81 leaders. The following selected results shed light on the role of institution management in establishing ESD at the childcare centre, with a focus on the impact of the introduc-

tory workshop Tür auf! Mein Einstieg in Bildung für nachhaltige Entwicklung – "Open the door! My introduction to education for sustainable development" (for childcare centre directors) on the institution as a whole.

Multiplication at the institution – the particular role of the childcare centre leadership

As a new target group of the initiative, childcare centre directors have a key role to play because they can support the advancement of values among the team and children in terms of mindset and action, taking steps to ensure the entire childcare centre becomes a place of learning for sustainable action. The professional development workshops support childcare centre directors in developing their own position on sustainability and ESD in their own management, in planning and implementing projects as part of educational management, in developing initial ideas for networking in connection with ESD and in shaping the development of their childcare centre through a process of participatory change.

Childcare leader directors usually opt to attend the relevant ESD workshop themselves; less frequently attendance is suggested by the provider organisation or the team. The leaders show significant interest in the educational concept and are highly motivated. They expect the workshop to provide them with practical tips for implementation at the childcare centre: they seek to extend their expertise and receive input on how to transfer the content of the workshop to the team and establish the educational concept at the childcare centre. When asked why they chose to attend the professional development workshop and what they expected from it, childcare centre directors typically answer:

"To move my childcare centre forward and provide the team with fresh stimuli."

"More information – I see myself as a multiplier for staff, parents, children."

"Helping my team on an ongoing basis to extend their own expertise. Encouraging the team to keep moving forward."

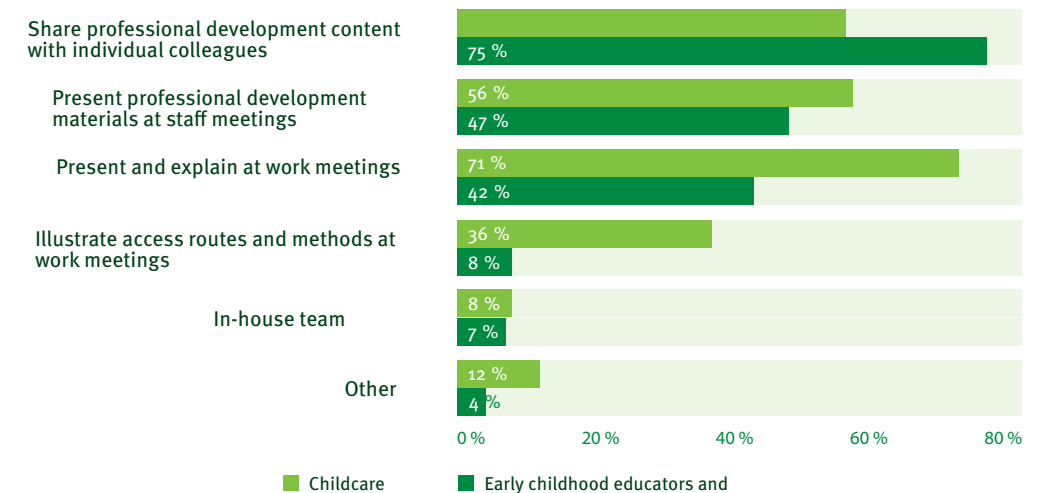
if the head of the childcare centre attends the professional development workshop, other members of the educational team will often take part as well. Approximately half of the leaders stated that other educators from their institution had attended the professional development workshop Tür auf! Mein Einstieg in Bildung für nachhaltige Entwicklung – "Open the door! My introduction to education for sustainable development" (23 per cent) or planned to do so that same year (25 per cent).

In order for the educational concept to have an impact on the institution as a whole, it is crucial for the expertise imparted in the workshop to be shared with the team. The evaluation shows that both educators and childcare centre directors share the content of the ESD professional development workshop with their colleagues at the institution: the majority of respondents say they share the content and methods of the workshop with other colleagues in some form or other. The way in which

the information is passed on differs between childcare centre directors and educators (see Figure 10): Educators share their expertise mainly through individual discussions with colleagues; they make less use of formal and binding regular appointments such as staff meetings to share documents or present content to colleagues.

Figure 10
Sharing of the content and methods of the ESD professional development workshop within the team

Data from 73 childcare centre directors and 132 educators (multiple answers possible)



There is a significantly higher number of leaders who use regular staff meetings to share the knowledge of content and methods they acquired at the ESD professional development workshop. In this way, they are able to reach the entire team and transfer ESD to the institution as a whole. This illustrates the particular importance of childcare centre leadership in passing on the content of professional development.

Signs of change – institutions are starting to embark on the journey

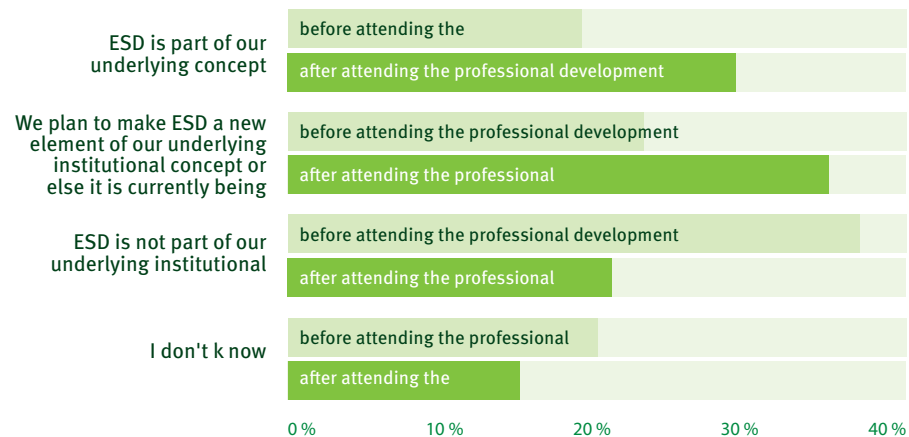
What signs of more far-reaching change can be observed at early childhood institutions? After attending the introductory professional development workshop and going through a practical phase of several months, 71 per cent of childcare centre directors and 78 per cent of the educators report that they implement ESD at the institution.

According to the directors, the educational concept is most often applied to educational work (projects on waste avoidance), though to some extent it is also applied more generally such as when placing orders (purchase of fair products). Less frequently, the educational concept is applied in the field of leadership and management (team discussions on the topic) or through networking with other stakeholders or institutions (Department of the Environment).

There are only a small number of institutions at which ESD is firmly established as a concept prior to attendance at the professional development workshop. By contrast, two to four months after workshop attendance, ESD can more frequently be seen to be incorporated or planned as part of the underlying institutional concept (see Figure 11).

Figure 11
ESD as part of the underlying institutional concept

Data from 145 educators



Furthermore, about two thirds of childcare centre directors and one third of educators stated that they noticed changes at the institution after attending the professional development workshop. They said these primarily concerned more critical use of resources (nature, water, materials) and more frequent use of ESD-typical methods and approaches (engaging in philosophical debate with children, project work). More than a third of leaders also said they went on to include ESD in their staff development. Only sporadic instances were reported of changes with regard to the organisational structure, the premises, external links and permanent integration of the educational concept in the institution's activities. This means that after attending the first ESD professional development workshop *Tür auf! Mein Einstieg in Bildung für nachhaltige Entwicklung – "Open the door! My introduction to education for sustainable development"*, the institutions did not yet undergo any fundamental organisational change. However, initial implementation steps were recognisable in accordance with the objective of the introductory workshop.

Summary: Impact at the institutional level

One part of the overall evaluation of the professional development concept on the subject of Education for Sustainable Development focuses on the impact at the institutional level, looking at the role of childcare centre directors based on longitudinal surveys of more than 230 educators and leaders.

Childcare centre directors act as multipliers at their institution. They transfer the educational concept to the institution and share their expertise with the team. Two to four months after the professional development workshop, the first impacts become apparent at the level of the institution: ESD is increasingly being integrated into the underlying concept. Changes at the institution are perceived in particular by the leadership. There is critical reflection on the use of resources and ESD is more firmly established in educational practice. Less often, after attending the introductory professional development workshop, ESD is to be found in the structures of the institution such as its underlying educational concept or in the area of leadership, management and networking.

All in all, the initial impact can be seen mainly with regard to educational practice and less at the level of the childcare centre as a whole. This is in line with the objective of the introductory professional development workshop and can also be seen as confirmation of the sequential nature of the programme: implementation of ESD at the institution is a process; by attending the introductory workshop, participants embark on the journey.

More on the evaluation of the ESD professional development workshops in Volume 12 of the academic publication series (cf. Stiftung Haus der kleinen Forscher, 2019d)

Consolidation of the results

The previous sections presented the results of various studies from the Foundation's own monitoring. These show the impact of the initiative's professional development programme at different levels.

1st level (participants' response): The first level is that of educators' satisfaction with the professional development offered. Post-attendance feedback on all topics relating to face-to-face professional development indicates that participants are very satisfied – as was the case in previous years.

2nd level (participants' learning success): In order for the initiative to have an impact at the level of day-to-day educational practice, there needs to be a change in educators' mindset and action. This is why the Haus der kleinen Forscher professional development programme aims to ensure that educators are able to expand their skills by attending one of the workshops. Results of a longitudinal survey with more than 1,500 participants across all face-to-face workshops show an impact on learning success in various skill areas. When they were questioned immediately after attending a workshop, educators rated themselves more highly than before with regard to their self-confidence in implementing a topic, their expertise, their motivation and their self-efficacy in relation to exploration and inquiry-based activities with children. In addition, group comparisons focusing on participants' experience of the professional development in the latter three target areas show that the initiative's professional development programme is also having a long-term impact: the more workshops educators attend, the higher they rate their own skill level.

In the longitudinal survey presented here, it has been possible for the first time to demonstrate a link between attendance at professional development workshop and skill development in educators. The findings relating to learning success as a result of attending a Haus der kleinen Forscher professional development workshop match the results presented in the 2016/2017 Monitoring Report (cf. Stiftung Haus der kleinen Forscher, 2017a). The results of the group comparison based on professional development experience tie in with findings generated by the external research project EASI Science, where educators who have undergone professional development in science have a higher level of subject expertise and a better grasp of subject-specific teaching methodology than a comparison group lacking this professional development (cf. Steffensky et al., 2018).

3rd level (participants' transfer success): In the transfer phases after workshop attendance and during follow-up professional development, educators are able to reflect on and adapt their educational practice based on the skills they have acquired. If this step is successful, workshop attendance can have a crucial impact on the interactions between educators and the children. According to a qualitative sub-study as part of the evaluation of the professional development workshop *Informatik entdecken – mit und ohne Computer* ("Discovering computer science – with and without computers") – which was carried out three months after the workshop – educators were implementing computer science education in their day-to-day practice more naturally and with greater confidence. Factors

inhibiting practical application included a lack of technical equipment at the institution and to some extent also reservations on the part of parents and colleagues. On the other hand, educators felt that good communication of workshop content within the team and the establishment of computer science education as part of the underlying institutional concept were conducive to implementation.

4th level (impact at the institutional level): Another important prerequisite for the initiated changes to have a lasting effect – i.e. a long-term impact on children's day-to-day learning and experience – is not only regular participation in the initiative's professional development programme by educators and leaders but also the establishment of workshop content at the level of the educational institution as a whole. This highlights the key role played by the institution leadership in sharing workshop content with the team and helping establishing the educational concept at the childcare centre. This is the only way to create structures that will sustainably improve early STEM education in Germany. The results of the evaluation of successive ESD professional development workshops for educators and, for the first time, also specifically for childcare centre directors, show an impact in particular with regard to educational practice. The implementation of ESD at the institution as a whole is a long-term process that childcare centre directors promote by attending the relevant professional development workshops.

The results presented in the Monitoring Report show that educators are satisfied with the professional development offered by the initiative. In addition, attending Haus der kleinen Forscher workshops helps them extend their professional skills. Implementation of workshop content in educational practice succeeds well in the case of the individual educators questioned in the survey, though integrating it in a more broad-based manner in institutional structures and day-to-day routine is more challenging. Exploration and inquiry-based learning in day-to-day educational practice can only succeed if the educational concepts are established within the institution as a whole, too.

The changes achieved by the initiative's professional development programme at the institutional level will be a future focus of the Foundation's evaluation measures (see page 43). All in all, the results of this Monitoring Report indicate that the Haus der kleinen Forscher professional development programme is having the desired impact, confirming that these activities should be continued.

Future perspectives

Based on the fundamental question of the impact of the Haus der kleinen Forscher professional development programme, it is of particular interest in terms of the relevant evaluation and Foundation monitoring to assess how the educational initiative contributes to sound early STEM education for sustainable development. Generally speaking, more and longer-term research is needed to be able to specifically verify and empirically demonstrate the impact and effectiveness of the professional development programme. A longitudinal perspective has an increasingly important role to play here in obtaining information about short, medium and long-term changes resulting from attendance at a Haus der kleinen Forscher professional development workshop. Future surveys need to be conducted over longer periods of time and draw on larger samples in order to obtain representative results.

The individual approach of the initiative's previous professional development workshops – focusing on the educator as such – is to be expanded in future to include a systemic perspective that emphasises the institutional establishment of professional development at Haus der kleinen Forscher institutions, also with the aim of gearing the programme towards the management level of childcare centres. The Foundation has already started to implement this by offering workshops for leaders as part of the ESD project (see page 36). The Foundation links programme theory and evaluation measures so as to be able to assess the implementation of workshop content throughout the institution as a whole. This is also the point of departure of the Foundation's new childcare programme KiQ – gemeinsam für Kita-Qualität: Wenn Entdecken und Forschen zum Alltag werden ("KiQ – working together for quality childcare: when exploration and inquiry become part of day-to-day routine"). This strengthens the ongoing development of the childcare centre as a whole and is offered for both educators and childcare centre directors in tandem since 2019, with a view to establishing exploration and inquiry-based learning as a shared educational mission at childcare centres in the long term (see page 44). In this way, the Foundation is focusing more on the link between continuous participation in professional development workshops, organisational development processes and the impact on the educational institution as a whole.

The pages that follow present a selection of key projects and innovative developments that the Haus der kleinen Forscher initiative will be implementing in the upcoming period to contribute to quality early STEM education for sustainable development.

Childcare centre programme KiQ – gemeinsam für Kita-Qualität: Wenn Entdecken und Forschen zum Alltag werden ("KiQ – working together for quality childcare: when exploration and inquiry become part of day-to-day routine")

The Haus der kleinen Forscher professional development programme has so far focused on offering educators a variety of well-prepared STEM topics for interaction with children. However, the Foundation's latest impact studies show that successful transfer of professional development content to the institution as a whole – i.e. integrating the topics in day-to-day routine, implementing new ideas on a trial basis and adapting these to the structures of the childcare centre – often still requires additional support (cf. Stiftung Haus der kleinen Forscher, 2018a).

In March 2019, the Foundation began developing the new childcare centre programme KiQ – gemeinsam für Kita-Qualität ("KiQ – working together for quality childcare"). This programme aims to support childcare centres in establishing exploration and inquiry-based learning as a shared educational mission in their day-to-day routine in the long term, thereby increasing the educational quality of their institutions. Changes within the childcare centre in terms of organisational development are of particular importance here.

The "KiQ" programme is designed to run for just under two years and provides for a modular series of professional development activities pursued by one educator and one leader from each childcare centre. The activities take the form of blended learning, i.e. face-to-face, practical and online activities are deliberately interlinked. In addition, participating childcare centres benefit from professional process support for the transfer of workshop content to educational practice, accompanying the institutions in the implementation of their specific measures as they establish exploration and inquiry-based learning on a day-to-day basis. In addition, the institutions participating in the model phase are encouraged to engage in online knowledge-sharing and establish regional learning communities dedicated to exploration and inquiry-based learning.

In a pilot phase starting in May 2020, the programme is to be piloted at 100 childcare centres in four model regions. The Haus der kleinen Forscher Foundation develops these activities in close cooperation with academics and expert practitioners. During the model phase, "KiQ" will be scientifically evaluated both internally and externally.



Forum KITA-Entwicklung

Forum KITA-Entwicklung (“Childcare Centre Development Forum”) is an innovative project being pursued by the Haus der kleinen Forscher Foundation in cooperation with the Robert Bosch Foundation. It explores the question of how organisational development at childcare centres can contribute to high-quality education and seeks to develop potential forms of action to this end. The starting point is that systematic organisational development is essential in order to sustainably implement changes in the “childcare system” – at various levels – so as to contribute to improved quality. The results provide the Haus der kleinen Forscher Foundation with fresh insights into how high-quality early STEM education can be established at institutions. Numerous other actors in the education system can benefit from this, too.

The key questions are as follows: What is the relationship between organisational development and quality development? What practical knowledge is available at the various levels of the “childcare system”? What are the political regulations that define the scope for quality development? Which individuals and institutions need to be involved so that improvements can be achieved? In this way, a theoretically and empirically-based model of how the “childcare system” functions is to emerge, which will provide a starting point for the implementation of systematic organisational development in institutions.

The project team analyses the field of organisational development at childcare centres. On this basis, individual measures are derived, tested and evaluated in order to review and further develop the model that has been developed.

Academic experts and practitioners prepare assessments and provide advice throughout the project period. Proposals for action are to be made for all actors involved in the “childcare system”: the project team relay these to the right addressees by means of public relations work, political agenda-setting and discourse with academia and childcare professionals.

MINT ist überall“ – an across-the-board STEM professional development programme



The educational programme MINT ist überall (“STEM is everywhere”) addresses the entire STEM education sector. Children’s day-to-day lives are taken as the starting point: where are there links with mathematics, computer science, natural sciences or technology? How can STEM-related learning situations emerge from these links? And how can the children be provided with sound support by educators?

This new professional development programme makes it easier for educators to recognise the enormous potential of day-to-day situations in relation to STEM education, enabling them to develop their own ideas as to how these opportunities can be taken up and pursued in greater depth. It consists of a face-to-face professional development workshop, several online activities with varying focus areas and a range of educational materials with diverse learning and dialogue opportunities for educators. All formats can be used independently of each other depending on individual interests, needs and time resources.

Dialogue between the educators is a central aspect of this new programme. For example, individual experiences are shared and discussed, and video sequences of children aged between 3 and 10 in day-to-day situations are watched and analysed together. There is an introduction to teaching materials as tools for practical use – such as the question fan or the STEM game. All in all, the professional development programme focuses on methods of learning support that apply to the entire STEM field.

The face-to-face professional development workshops for trainers are to be held from autumn 2019 onwards. Subsequently, the MINT ist überall (“STEM is everywhere”) professional development workshops will be offered throughout all networks of the Haus der kleinen Forscher initiative, enabling educators to participate nationwide.



Energiebildung im Grundschulunterricht (“Energy education in the primary school classroom”) – launch of nationwide blended learning professional development for educators

For the first time, the Haus der kleinen Forscher Foundation is currently developing professional development workshops that are specifically aimed at primary school teachers. From March 2019 to June 2020, the PRIMA!Start project (funded by the Federal Ministry of Education and Research) will lay the foundations for expanding teachers’ skills in the domains of subject expertise, subject-specific teaching methodology and educational theory by means of professional development workshops aimed at specific target groups.

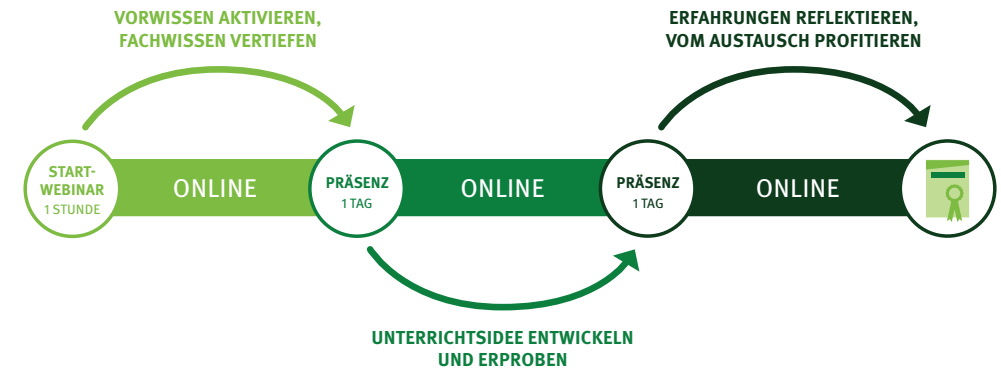
The first professional development topic will be Energiebildung im Grundschulunterricht (“Energy education in the primary school classroom”). This workshop will enable educators to teach general science in a child-oriented way, gearing presentation of the subject matter to the children’s own living environment. In 2020, the topic will be Informatische Bildung im Grundschulunterricht (“Computer science education in the primary school classroom”).

The professional development workshops will bring teachers into contact with contemporary digital learning opportunities, aiming to break down barriers and promote positive experience. For this reason, a blended learning format is being developed for the first time, consisting of alternating and interrelated online and classroom phases (see Figure 12). In this way, the teachers will be able to apply the expertise they have acquired in the classroom, share their experience on an ongoing basis and provide mutual support for further development.



Figure 12
Structure of the professional development workshop Energiebildung im Grundschulunterricht (“Energy education in the primary school classroom”)

Fortbildungsstruktur



Along with its professional development workshops, the initiative is seeking to extend and evolve its professional development structures so as to enable the programme to be implemented in the federal states. From autumn 2019, teachers in Hesse will initially be able to take part. The Hessian Ministry of Education and Cultural Affairs commissioned the professional development workshops and financed their implementation as part of the PRIMA!Hessen project.

International Dialogue on STEM Education (IDoS) – developing a global vision for future-oriented early education

The world is changing rapidly. Global developments such as digitalisation and climate change, increasing social inequality and migration will continue to shape the lives of those who are now at pre-school age. In this complex world, education should help children become self-determined adults who have a perspective on global challenges and are capable of assessing them and being involved in creating a response.

Tackling this kind of challenge requires an interdisciplinary approach and holistic skills. As such, the STEM disciplines are also called upon here to get involved in the society-wide process of searching, learning and engagement when it comes to resolving global sustainability issues, and there should be reflection on how they can contribute to (non-) sustainable developments.

For this reason, the “International Dialogue on STEM Education” 2019 with its main topic “STEM Education for Sustainable Development” brings together some 100 international academics and decision-makers from politics, business, society and culture, as well as representatives of leading STEM educational initiatives worldwide to explore the question: how can we empower children to help shape sustainable societies through STEM education?

The Global Forum on Early STEM Education, newly established in 2017, will take place on 5 and 6 December 2019 at the Berlin branch of the Robert Bosch Foundation. IDoS is a dialogue format run by the Haus der kleinen Forscher Foundation and the Siemens Foundation that focuses on early STEM education (children from the age of 3 to approximately 10).

It is organised under the patronage of the German UNESCO Commission. Other partners and sponsors are the Federal Foreign Office, the Robert Bosch Foundation and the OECD.

Haben Sie Fragen, Anmerkungen oder Anregungen zu diesem Bericht oder zur wissenschaftlichen Begleitung der Stiftungsarbeit?

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